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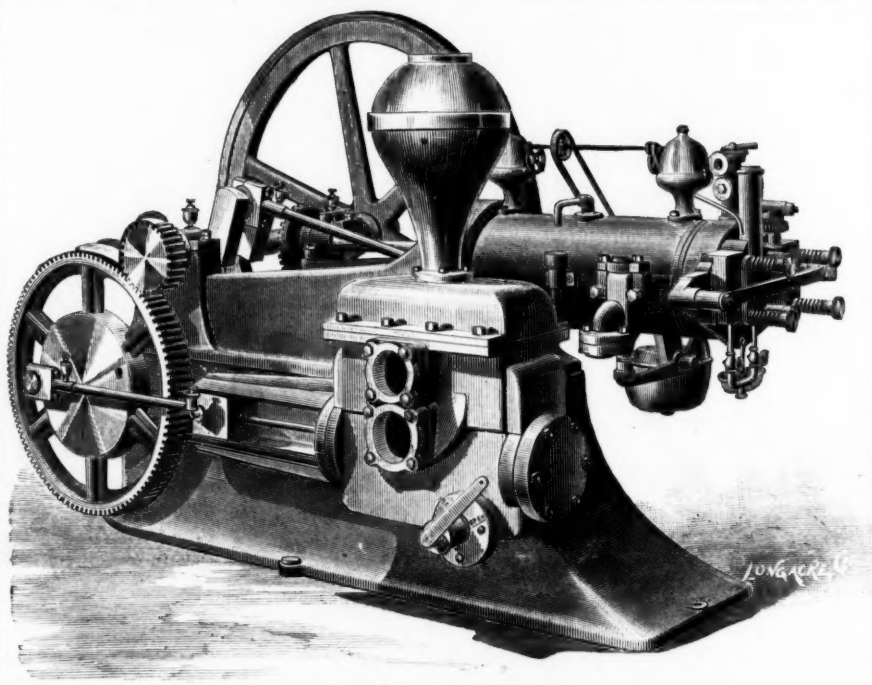
Otto Gas Engine and Pump Combined, with By-Pass Valve.

For some time past there has been a growing demand for combined gas engines and pumps for various purposes, but more particularly for use in connection with hydraulic elevators.

As the gas engine cannot be started with its load of work on, generally a friction clutch was used between the engine and pump to disconnect the latter for the purpose of starting the engine. An automatic means to stop delivery of water, when upper elevator tank was filled, had also to be devised, and this was generally accomplished by opening of a valve at lower end of delivery pipe, through which the water was returned into the same tank from whence it was taken. The engine was thus relieved of pumping to any considerable height, though some power was spent in returning the water at a few feet of elevation. The by-pass valve adapted to engine herewith illustrated, secures marked advantages both in starting the engine and dispensing with the friction clutch, and in respect to the automatic regulation of water supply during continuance of motion of engine. It consists of a separate passage below the pump-barrel, which communicates with the opposite ends of the barrel, and of a transverse valve or cock, by which this passage may be opened or closed. When this valve is turned so as to obstruct the passage, the pump works as usual, but when the valve is turned so as to open the passage, the water flows directly from one end of the pump-barrel to the other, and does not pass the valves. In starting the engine, therefore, the by-pass is opened and permits the operation of the pump with but little effort, while as soon as the engine is running the valve is closed and the pump thrown into effective action.

To stop or renew the flow of water while the engine continues running, the same valve is opened or closed, and instead of the lever being worked by hand, it is acted on by a float in one of the elevated tanks. The engine is thus either fully loaded or entirely relieved of all work, and no power is wasted during the intervals that no water is delivered to upper tanks. The gas consumed corresponds, then, to the friction in engine and slow motion of pump-piston, being only about one-fifth of the possible total consumption of a given size. Besides the saving secured by this by-pass in running expenses, it reduces the first cost of the machinery by dispensing with the piping, valves and cocks necessary to return water to the lower tank, and with the friction clutch formerly used between the engine and pump, and at the same time it simplifies the entire pumping plant. It combines two separate elements formerly used in this kind of machinery in one, which is more simple than any one of the two it replaces simultaneously, viz.: the friction clutch, and the valve and piping discharging into the lower tank. The pumps connected with the "Otto" engines are large, with slow movement to avoid hammering, and to secure the greatest possible useful effect.

This combined engine and pump is made by Schleicher, Schumm & Co., Philadelphia, Pa.



GAS ENGINE AND PUMP.

The daily press is showing up by pictorial illustrations Captain Eads' projected Tehauntepec ship railway. The ship shown in the process of transportation in these illustrations may be all right, but the locomotives hauling it are represented as "fearfully and wonderfully" arranged. We suppose, however, that if the railway is constructed no serious objections will be made to the use of ordinary locomotives. If it was necessary to construct those of the kind shown, it would delay the undertaking indefinitely. Many are inclined to make light of Captain Eads' projects, but plans proposed by an engineer who has been so successful in previous undertakings are at least worthy of serious consideration, which they will undoubtedly eventually receive.

Plate Planer.

The plate-planing machine is fast coming to be considered an almost indispensable machine for a well-equipped boiler shop. It does the work much more satisfactorily than it can be done by chipping, and in a small fraction of the time, leaving true, straight bevels convenient for caulking, and which present straight, true lines when done. It bevels the edge of the plate, and squares up a narrow caulking edge.

The machine illustrated is arranged to plane sheets 14 feet to 16 feet long at one setting, and any length by re-setting. The housings are gapped to allow the sheet to be moved endwise for this purpose. There are two independent tools on the saddle, and the cut is taken in both directions. The carriage is carried by a large steel screw, supported at the center to prevent sag or deflection.

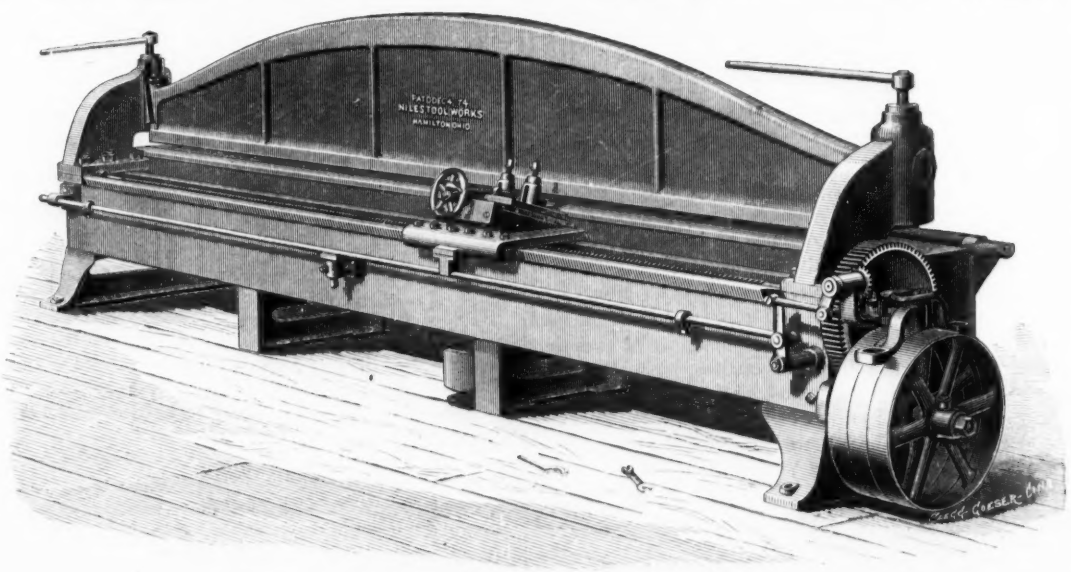


PLATE PLANER.

The plate is held by a heavy and substantial clamping-bar, held by a screw at each end only. This bar takes the strain of the work, and should, therefore, be a substantial casting, which is the case in the machine illustrated. The clamping is done very quickly and securely. Brackets project out from the back of the bed carrying rollers for supporting the plate and facilitating handling.

The machine throughout is strong and substantial. It is built from new designs and patterns by the Niles Tool Works, Hamilton, Ohio.

System in Machine Shops.

BY OBERLIN SMITH.

In the modern machine shop, thoroughly systematic methods are of the utmost importance, not only to insure good quality in its products, but to enable them to be made cheaply enough to comply with the commercial conditions necessary to the existence of the shop itself. This statement must be somewhat modified in the case of a shop which is purely a "job shop," that is, where the work is chiefly repairing miscellaneous machinery, together with the occasional construction of odd machines from other people's designs and drawings; or, perhaps, with no drawings at all, and very little design of any kind.

In such shops the method of doing work and the kind of tools used, must generally be left to the judgment of the individual workman, as the expense would be too great were each particular job studied out and drawings of it made in the drafting room. Such expenses are permissible only when a job is to be done several times exactly alike, or when, for some other reason, an accurate record of it is necessary. It is obvious that the workmen employed for such transient jobs must possess skill and judgment, together with a wide experience in miscellaneous work, as upon them, rather than upon a head designer and his corps of draftsmen, will depend the reputation and ultimate success of the concern.

At the other extreme, from the job shop referred to, stands the *manufacturing machine shop*, where hundreds or thousands of pieces are made exactly alike, and where the utmost system is absolutely necessary in every detail, the economy and uniformity of production comparing with that of the job shop, just as does the modern printed page to the manuscripts of the middle ages, or the stamped-out coin to the hand-carved medallion. Instances of such shops, or rather factories, are now found wherever guns, sewing-machines, type-writers, locks or analogous articles intended for extensive popular use are made upon a commercial scale. There is not room in this paper to describe the wonderfully accurate gauges, special tools and automatic machines used in such factories, where the cost of the apparatus necessary for economical production is perhaps from a thousand to a hundred thousand times the value of any one of the individual articles produced. In such a system of work much cheaper labor may,

upon an average, be used, than in the job shops; as each workman need know but his own special operation, and, on account of repeating it so often, may soon be trained to such skill as is necessary to operate the tools which, in some cases, almost do the thinking themselves, or rather, which have embodied in them the stored-up thoughts of their highly skilled inventor. Of course a few workmen of a very high grade are needed to make, keep in order and superintend the work of these accurate tools, but the great bulk of the laborers can soon be trained from material of the crudest kind.

Between the two extremes thus indicated we may place the *average machine shop*, which now-a-days is apt to have some specialty or specialties for the great bulk of its work, as for instance, machine tools, or steam-engines or printing-presses, etc., etc. Such shops usually do some repairing in their own particular line, and perhaps some odd job work that may happen to come to them. This allies them to the job shop to some extent, and for such work they must have a few general-utility men, as before described. The majority of their work, however, is made up in batches of, perhaps, from three to twelve machines at a time, and in the case of very large work, such as marine engines, etc., of only one at a time.

Whatever may have been the case twenty-five years ago, it is certain that at the present time such a shop, to be successful, must, in the first place, make accurate drawings of all new work produced in the way of staple articles to put upon the market, not only as a whole, but in respect to each individual piece. It is highly desirable that such drawings should be made upon a uniform system, and that they should be carefully classified and indexed.

In the second place, each kind of machine built, and each piece thereof, should have a definite name, as concise and suggestive as possible, and also a symbol to facilitate a briefer reference to it upon drawings, patterns and special tools, than could be expressed by using the whole name. These symbols should, of course, belong to said machines and pieces alone, without any possibility of their being used for any other purpose, or confused with other articles manufactured by the same concern.

In the third place, as complete a set of gauges, jigs and other special tools should be provided for the manufacture of each piece as is warranted by the probable amount of production. These, of course, cannot usually be provided to the same extent as they are in the regular factories, where pieces are produced by thousands, or millions. In speaking of special tools, patterns used for foundry moulding are included, and these, as well as the other tools referred to, should be properly marked with the symbols before described, and kept in pattern-rooms or tool-rooms, each having its definite place. This place should of course be labeled with the same symbol, and should be easily found by a proper system of indexing. The number of these special tools can obviously be increased from time to time, as the size of the batches made at one time increases. This usually occurs in the case of successful machines, after they have been so experimented with, improved and perfected as to become staple articles.

Aside from these *special* patterns and tools, there is, in ordinary shops, a large variety of *general* machines and tools which are used in common by a number of men and for different work. Such tools should be accurate and adapted to making the various pieces of the work fit each other with the proper degree of tightness. Not only should a piece, whose fitted surface is exterior, fit properly the interior surface of another piece in which perhaps it slides or revolves (as, *e.g.*, a shaft in its "bearing"), as regards the particular machine of which it forms a part, but such piece should conform to some standard size, so that it will fit into other similar machines of the same class as its own. Hence we have *limit gauges* and accurate tools for determining and maintaining standards. This principle carried out to its full extent gives us "interchangeability," the basis of the wonderful cheapness of production which has been attained in the machine *factories* before referred to—as in sewing-machines, watches, guns, etc.

In the ordinary machine shop under consideration, this system should undoubtedly be used in the cases of shafts and other cylindrical rods fitting the holes in which they slide or revolve, or in which they are fastened; rectangular sliding rods in their bearings; keys and feathers in their key-seats; screws in their nuts; tapering shanks or plugs in their sockets, etc., etc. In the case of screws, the pitch should be kept to a standard, and also the width, depth, and shape of thread, as well as the diameter of the screw itself. The length of journals, the thickness of lever-hubs between their side bearings, and other analogous measurements should also be kept to standards—except, perhaps, where the "loose-collar" system is used. The principle embodied in this system is a typical one and, in various constructions, enables us to have interchangeability, without strict uniformity of dimensions.

In speaking of accuracy of measurement, it must be borne in mind that the term is only *relative*, and that, while the land surveyor *thinks* in tenths of a foot, the shoemaker in thirds of an inch, the carpenter in eighths of an inch, the modern machinist must often think in thousandths of an inch or less, where his grandfather thought in sixteenths and his father in sixty-fourths. Furthermore, the man who originates and manufactures the gauges, etc., for shop use, and the master-gauges necessary for their maintenance to a standard, must think and work in hundred-thousandths of an inch; indeed, in at least one shop in this country, some of the measurements are in quarter-millionths.

Now, in practical machine construction, the question is constantly occurring as to how tight or loose one piece of metal shall be made to fit another, or how tight each shall fit its respective gauge. This is all arranged by the designer in the case of gun-work, etc., and sets of *limit gauges* are provided, which fix the amount of variation permissible in any measurement, and thus provide for thorough interchangeability. In ordinary work, however, where the expense of such gauges cannot be afforded, there is frequently trouble in fitting, owing to the slight variations from absolute size which must necessarily occur, but which are not exactly limited in amount. An illustration of this is where a shaft, nominally, say, 1″ diameter, is to go in the hole forming its bearing with a "running fit." This is usually from .001″ to .002″ loose, to insure no "binding" and give room for oil. Let us say that the intention is to make the hole 1″ and the shaft .999″. It is clear that the limit of variation, downwards in the hole and upwards in the shaft, must never be as much as .0005″, or else there would be a *jam* if both these variations happened together, and in directions towards each other. With a variation of .0004″ allowed, they would always be .0002″ or more loose. Practically, even with fine workmen, the variations will be such as to prevent similar parts of machines, built in different batches, from being interchanged; hence, in order to produce work cheaply and uniformly, there should be a radical reform in the method of marking dimensions upon drawings. This marking should be simple and uniform, and should state the greatest amount of variation in each direction from the normal size, as well as the normal size itself. This latter should, in many cases (*e. g.*, in the example above), be different in the shaft and hole (or other fitted parts) by an amount *more than twice the maximum variation*. The difference between the two dimensions would, of course, express the normal looseness. This would sometimes, as in the case of a "driving" fit, be expressed by a cipher or a negative quantity. It is obvious that such a system would produce much better results than the present one of instructing the workman to make a hole 1″ and a shaft 1″, leaving him to disobey orders by using his individual judgment as to the variations, and getting different average amounts with different men, dependent upon their "personal equations" of accuracy and—good luck.

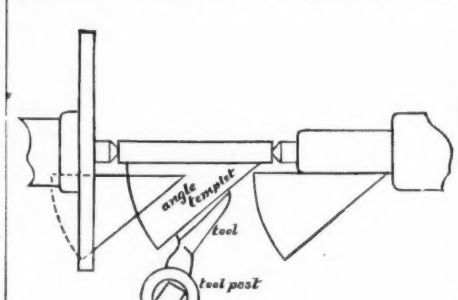
Without entering into further details regarding this interesting subject, the writer will, in the small space here available, only say further that, in his opinion, the adoption of such a reform, together with careful attention to matters pointed out in the beginning of this article, would be a not unimportant means of increasing the efficiency of our machine shops—institutions which rank more and more as leading factors in our modern civilization.

Chart and Tables for Bevel Gears.

A NEW, SIMPLE AND ACCURATE METHOD FOR FINDING THE ANGLES AND DIAMETERS OF ANY PAIR OF BEVEL GEARS BY SIMPLE CALCULATION, AND WITHOUT DRAFTING INSTRUMENTS OR SPECIAL TOOLS.

By George B. Grant, Boston.

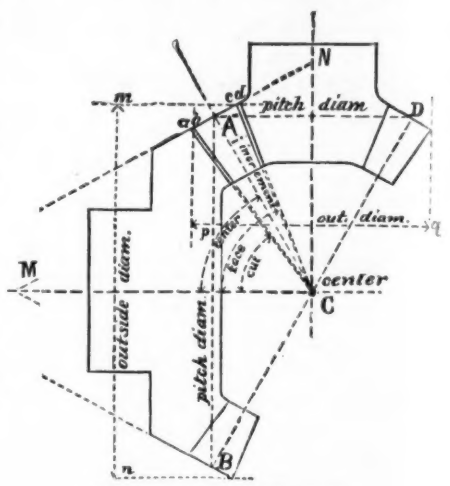
Not one machinist in a dozen will admit that he does not know how to properly shape a bevel-gear blank; but, when put to the test, not one in a score can do it well without an amount of fussing with drafting instruments, and a deal of studying and figuring



Practical Application in the Shop.

that looks ridiculous to one who has studied the subject, and knows how simple it really is when it is once thoroughly understood.

The average bevel-gear blank can be relied upon to be wrong in its face angle, or its outside diameter, or both, even when it has been shaped by a competent and intelligent general workman, and the simple explanation is that the only reliance is generally a hurried and poorly-made drawing from which the angles and diameters must be found by measurement, and used with many chances of error.



Explanation of Method.

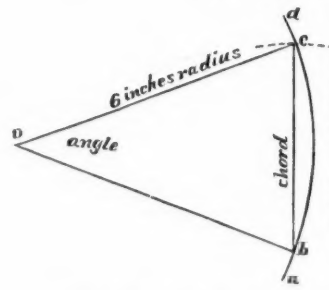
This method proceeds by simple calculation, avoiding the use of drafting instruments, and it will be found to be not only much more accurate, but at the same time much easier and quicker than any other method. The workman who can remember the numbers 1.41 and 81 and the angle 45° needs no further assistance on miter gears, and on other proportions needs the table only to supply equally simple data, while two to five minutes is sufficient time for any set of calculations after the method has been learned.

This matter is of more importance than is generally supposed, for bevel gears, unlike spur gears, must be exactly correct in diameters and angles, or no amount of perfection in the cutter or care in the cutting will prevent a botch.

Explanation of the Method.

The measures that must be given in advance are the pitch diameters *A B* and *A D*,

ANGLE TEMPLETS.



To make an angle templet by the use of the table of chords, draw an arc a d on paper or sheet metal with the dividers set to six inches. Then set the dividers to the chord of the angle and lay it off on the arc, as at b c. Cut to the lines b o and c o.

Similarly, an angle drawn on paper can be measured by drawing an arc across it at a radius of 6″, measuring the chord, and comparing with the table.

TABLE OF CHORDS OF ANGLES,

AT RADIUS OF SIX INCHES.

Degrees	Chord.	Tenths.	Degrees	Chord.	Tenths.	Degrees	Chord.	Tenths.
1	.10		31	3.20		61	6.10	
2	.20		32	3.31		62	6.19	
3	.31		33	3.41		63	6.28	
4	.42		34	3.51		64	6.36	
5	.52		35	3.61		65	6.45	
6	.62		36	3.71		66	6.54	
7	.73		37	3.81		67	6.62	
8	.84		38	3.91		68	6.71	
9	.94		39	4.01		69	6.80	
10	1.04		40	4.10		70	6.89	
11	1.15		41	4.20		71	6.97	
12	1.26		42	4.30		72	7.06	
13	1.36		43	4.40		73	7.14	
14	1.46	.1—.01	44	4.50	.1—.01	74	7.22	.1—.01
15	1.57	.2—.03	45	4.60	.2—.02	75	7.31	.2—.02
16	1.67	.4—.04	46	4.69	.3—.03	76	7.39	.3—.02
17	1.77	.5—.05	47	4.79	.4—.04	77	7.47	.4—.03
18	1.87	.6—.06	48	4.88	.5—.05	78	7.55	.5—.04
19	1.98	.7—.07	49	4.98	.6—.05	79	7.63	.6—.05
20	2.08	.8—.08	50	5.08	.7—.06	80	7.71	.7—.06
21	2.18	.9—.09	51	5.17	.8—.07	81	7.79	.8—.06
22	2.29		52	5.26	.9—.08	82	7.87	.9—.07
23	2.39		53	5.35		83	7.95	
24	2.49		54	5.45		84	8.03	
25	2.59		55	5.54		85	8.11	
26	2.70		56	5.63		86	8.18	
27	2.80		57	5.72		87	8.26	
28	2.90		58	5.82		88	8.34	
29	3.00		59	5.91		89	8.41	
30	3.10		60	6.00		90	8.48	

The table gives the length of the chord at six inches from center, for any degree. For tenths of a degree, add the value in the small table of the same column.

and the numbers of teeth or the diametral pitch, and the measures that must be determined before the blank can be shaped are—

1st. The outside diameters *m n* and *p q*, each equal to the pitch diameter plus a small increment.

2d. The center angles *A C M* and *A C N*.

3d. The face angles *c C M* and *b C N*, each equal to the center angle plus a small increment.

4th. The cutting angles *a C M* and *d C N*, each equal to the center angle minus a small increment.

Of course, all these can be found by first making a drawing and then measuring the diameters and angles; but, although the process is simple enough, and perhaps preferable in some cases in the hands of a draftsman who has the proper tools to use and the skill and knowledge to use them properly, still, it is not well adapted to ready and general use in the shop.

Unless made with good instruments that are handled with great care, a drawing is not accurate enough for the purpose, and its results, particularly as to angles, are not apt to be well carried out on the work. It is easy enough to find the proper face angle by a drawing, but not as easy to measure that angle and transfer it to the iron blank.

This method is entirely one of simple calculation, with no instrument but the pen, and no tools to apply its results in the shop but the ordinary scratching dividers and the scale. It is not only more accurate, but, after a few hours' work with the table on various examples, it will be easier to work and quicker than the graphical method.

PROCESS IN DETAIL.

First, find the proportion of the gears by dividing the diameter of the larger gear by that of the smaller, and then use the values in the table opposite that proportion.

The diameter increments are found by dividing the tabular increments by the pitch, and the outside diameters are found by adding the increments to the pitch diameters.

The angle increment is found by dividing the tabular increment by the number of teeth in the larger of the two gears. The face angle is the center angle plus the angle increment, and the cutting angle is the center angle minus one and one-sixth of the increment.

Example.—Given, pitch diameters, 6″ and 4″; pitch, 8; teeth, 48 and 32. The proportion is 6 to 4, or 3 to 2, or 1.5 to 1, and the table gives at 1.5 the center angles 56.3° and 33.7°, and the angle increments $\frac{2}{48} = 2°$, and $1\frac{1}{6}$ of $2° = 2.3°$, from which we find the face angles $56.3° + 2° = 58.3°$, and $33.7° + 2° = 35.7°$, and the cutting angles $56.3° - 2.3° = 54°$, and $33.7° - 2.3° = 31.4°$.

The diameter increments are

$$\frac{1.11}{8} = .14$$

and

$$\frac{1.66}{8} = .21$$

and from these we find the outside diameters $6. + .14 = 6.14″$, and $4. + .21 = 4.21″$.

When the proportion falls between two tabular proportions, we must use tabular angles and increments that are proportionally between the tabular values.

All diameters should be figured to the nearest hundredth of an inch, and all angles to the nearest tenth of a degree.

PRACTICAL APPLICATION IN THE SHOP.

The best tool for shaping a bevel gear is a compound and graduated slide rest which can be set directly to the angles, but as such an appliance is seldom to be found, and then seldom in good order, the work must generally be done by the use of angle templates.

To use the angle template, lay one edge against a straight shaft or mandrel held between centers, or against the tail spindle, and adjust a side tool or scraper to the other edge. If the back of the template be cut square with one edge it can be used by placing it against the face plate.

Be careful with the back angle, for the back of the tooth is not square with its face, and if it is turned square or in any way out of truth, the corners of the teeth will not fit true in the spaces of the mate gear, and the appearance of the job will be spoiled. The true back angle of each gear is the center-angle of the other gear of the pair.

SHAFTS NOT AT RIGHT ANGLES.

When, as it sometimes happens, the shafts are not at right angles, a simple preliminary drawing must be made. Lay off the shaft angle by means of the table of chords, draw two lines parallel to the shafts at the distances of the half pitch diameters, and from their intersection draw a conical line to the center.

Measure the center angle between either shaft and the conical line, and the proper increments will be found in the table at that center angle. If the center angle is less than 45°. the tabular angle increment must be divided by the number of teeth in the gear, as usual, and then divided by the tabular proportion.

Example.—It is found that the center angle of a gear of 8 pitch and 40 teeth is 35°, and this in the table gives the angle increment

$$\frac{94}{1.43 \times 40} = 1.6°,$$

and the diameter increment

$$\frac{1.63}{8} = .20.$$

Proceed separately with the other gear of the pair by measuring and using its center angle.

ERRORS IN DIAMETER.

It will often happen that the outside diameter will be turned too small, or that a casting will not quite turn to the desired size. In this case the diameter should be left as large as possible, and then the other, or mate gear, should be turned under size, to keep the correct proportion between the pitch diameters.

For example, if the smaller gear of a pair that are proportioned two to one is found to be $\frac{1}{32}$ inch under size, the larger gear must be turned twice as much, or $\frac{1}{16}$ inch under size.

Great care must be taken to have the smaller gear of an unequal pair very near to size, for any inaccuracy can be balanced only by a proportionally larger inaccuracy of the mate gear. If the smaller gear of a pair that are proportioned six to one is as much as $\frac{1}{32}$ of an inch under size, the larger gear must be turned $\frac{6}{32}$, or $\frac{3}{16}$ inch under size and this is enough to change the number of teeth, the proportion and the face, and spoil the work. The only remedy in such a case is to cut shallow teeth on the pinion, so that its pitch diameter is unchanged.

TABLE OF INCREMENTS AND ANGLES FOR BEVEL GEARS.

Proportion.		Diameter Increment. Divide by pitch.		Angle Increment Divide by number of teeth in larger gear	Center Angles.	
		Larger Gear.	Smaller Gear.		Larger Gear.	Smaller Gear.
1.00	1–1	1.41	1.14	81	45.0	45.0
1.05	——	1.37	1.42	84	46.4	43.6
1.10	——	1.35	1.44	86	47.7	42.3
1.11	10–9	1.34	1.46	87	48.0	42.0
1.13	9–8	1.33	1.47	87	48.5	41.5
1.14	8–7	1.32	1.49	88	48.7	41.3
1.15	——	1.31	1.50	89	49.0	41.0
1.17	7–6	1.30	1.52	89	49.5	40.5
1.20	6–5	1.28	1.54	90	50.2	39.8
1.25	5–4	1.25	1.56	91	51.3	38.7
1.29	9–7	1.24	1.58	91	52.2	37.8
1.30	——	1.22	1.59	92	52.4	37.6
1.33	4–3	1.20	1.60	93	53.1	36.9
1.35	——	1.18	1.61	93	53.5	36.5
1.40	7–5	1.16	1.62	94	54.5	35.5
1.43	10–7	1.15	1.63	94	55.0	35.0
1.45	——	1.13	1.65	95	55.4	34.6
1.50	3–2	1.11	1.66	95	56.3	33.7
1.55	——	1.09	1.67	96	57.2	32.8
1.60	8–5	1.07	1.68	96	58.0	32.0
1.65	——	1.05	1.70	97	58.8	31.2
1.67	5–3	1.03	1.72	98	59.1	30.9
1.70	——	1.01	1.73	99	59.5	30.5
1.75	7–4	.99	1.74	100	60.3	29.7
1.80	9–5	.97	1.75	101	61.0	29.0
1.85	——	.95	1.76	101	61.6	28.4
1.90	——	.93	1.77	101	62.2	27.8
1.95	——	.91	1.78	102	62.8	27.2
2.00	2–1	.89	1.79	102	63.5	26.5
2.10	——	.87	1.80	103	64.6	25.4
2.20	——	.84	1.81	103	65.5	24.5
2.25	9–4	.82	1.82	104	66.1	23.9
2.30	——	.80	1.83	104	66.5	23.5
2.33	7–3	.78	1.84	105	66.8	23.2
2.40	——	.76	1.85	105	67.4	22.6
2.50	5–2	.75	1.86	106	68.2	21.8
2.60	——	.73	1.86	106	68.9	21.1
2.67	8–3	.71	1.87	107	69.5	20.5
2.70	——	.69	1.87	107	69.7	20.3
2.80	——	.67	1.88	108	70.3	19.7
2.90	——	.65	1.89	108	71.0	19.0
3.00	3–1	.63	1.91	109	71.6	18.4
3.20	——	.60	1.92	109	72.7	17.3
3.33	10–3	.58	1.92	109	73.3	16.7
3.40	——	.56	1.92	110	73.6	16.4
3.50	7–2	.54	1.93	110	74.1	15.9
3.60	——	.52	1.93	110	74.5	15.5
3.80	——	.50	1.94	111	75.2	14.8
4.00	4–1	.49	1.94	111	76.0	14.0
4.20	——	.47	1.94	111	76.6	13.4
4.40	——	.45	1.94	111	77.2	12.8
4.50	9–2	.44	1.95	112	77.5	12.5
4.60	——	.42	1.95	112	77.7	12.3
4.80	——	.41	1.96	112	78.2	11.8
5.00	5–1	.39	1.96	112	78.7	11.3
5.20	——	.38	1.96	112	79.2	10.8
5.40	——	.37	1.96	112	79.5	10.5
5.60	——	.36	1.97	113	79.9	10.1
5.80	——	.34	1.97	113	80.2	9.8
6.00	6–1	.33	1.97	113	80.5	9.5
6.20	——	.32	1.97	113	80.8	9.2
6.40	——	.31	1.97	113	81.1	8.9
6.60	——	.30	1.97	113	81.4	8.6
6.80	——	.29	1.98	113	81.7	8.3
7.00	7–1	.28	1.98	113	81.9	8.1
7.20	——	.27	1.98	113	82.1	7.9
7.40	——	.27	1.98	113	82.3	7.7
7.60	——	.26	1.98	113	82.5	7.5
7.80	——	.26	1.98	113	82.7	7.3
8.00	8–1	.25	1.98	113	82.8	7.2
8.20	——	.24	1.98	114	83.1	6.9
8.40	——	.24	1.98	114	83.2	6.8
8.60	——	.23	1.98	114	83.3	6.7
8.80	——	.23	1.98	114	83.5	6.5
9.00	9–1	.22	1.99	114	83.7	6.3
9.20	——	.22	1.99	114	83.8	6.2
9.40	——	.21	1.99	114	84.0	6.0
9.60	——	.21	2.00	114	84.1	5.9
9.80	——	.20	2.00	115	84.2	5.8
10.00	10–1	.20	2.00	115	84.3	5.7

Cotton Manufacturing in New England.

The latest report of the Massachusetts Bureau of Statistics of Labor contains some very valuable figures. The summary statement of the report concerning the New England cotton industry is, that since 1831 the productive capacity of the operative, measured in pounds of product, has increased 145 per cent.; that this product is secured by the development of skill and by improved processes and machinery, whereby 184 per cent. more spindles are controlled by the average operative in 12 per cent. less time, and that measured in net value of product the productive capacity of the operative has increased 75 per cent., while the cost of product has been materially reduced to the consumer, and, that, notwithstanding the decrease in working time, wages have increased 97 per cent. In Massachusetts, working under a ten-hours law, the net product per operative, the basis of value, is greater than in any other Eastern State, though the operatives in the other States labor more hours per week. A smaller relative share of the net product in the manufacture of cotton goods, as has been said, goes to wages than in 1850, although productive processes have been so perfected and machinery so ingeniously adjusted as to render it possible to make a dollar's worth of net product to-day with over 70 per cent. less capital than was required to accomplish the same result in 1850. It is suggested with regard to this apparent exception to the general rule, that "perfection of machines and processes constantly tends to create a larger product with less capital, and the ratio of increase in productive capacity tends to outrun the ratio of increase in wages, so that of this larger product labor obtains a less relative share, although it is produced at less expenditure of time and effort, and rewarded by constantly increasing wages."—*The Textile Record.*

The Novelties Exhibition at Philadelphia.

The Philadelphia Tool Company, Philadelphia, Pa., exhibit a collection of old tin cans, tin workers' waste, and tin scrap, which had been buried 15 years. They also exhibit sash, and other weights which they make direct from the old tin, without mixing in iron or other metal. Their teams are seen gathering old tinware from vacant lots.

The Positive Water Meter Company, Front and Laurel streets, Philadelphia, Pa., display the Rowbotham Water Motor attached to and driving coffee mills, etc. These motors and also their meters, are built on the principle of two vanes passing loosely through a drum, which revolves in a case eccentric with the axis of the drum, and takes water upon an increasing radius, discharging it as the radius decreases, the vanes in length being equal to diameter of case.

An "open side planer," by Detrick & Harvey, Baltimore, Md., is shown at work. The face of the cross-beam and post are alike. The saddle can be used upon either. On the open side of the planer are two T-slots, the entire length of bed, to which are bolted brackets. Upon these brackets there is a rail or track, adjustable to and from the bed. A table corresponding in height to the planer platen slides upon this track. This table can be used for supporting long or wide pieces of work or will serve as a pivotal point to plane segments. The sliding table is moved simultaneously with the platen by bolting the work to it, or it may be moved by connecting rods.

A frictionless feed consumes power only when feeding, and is operated directly from the driving shaft. This planer was illustrated in the American Machinist of Feb. 14, 1885.

A. Whitney & Sons, of Philadelphia, exhibit car wheels to run loose on the axle, for mining and other purposes, without the necessity and expense of collars on the axle, and so as to exclude dust and dirt from the running parts, whilst at the same time they are well oiled with a minimum of oil. The hub of the wheel is closed on its outer end, and is provided with a recess into which a key-block is dropped, and with a chamber to hold the oil. The axle is turned with a groove in it near each end, into which the key-blocks fall when the wheels are in position, and in which they are secured by the plugs which close the oil chambers. An improved pedestal secures the axle to the body of the car, and excludes dust from the inside face of the hub. It can be adapted to round or square axles. By its use the wheels can be certainly and easily "spragged" in case of necessity, without damage to the sill of the car, and by a special contrivance the body bolts are so locked that they cannot be jarred from their position by "spragging" or other causes.

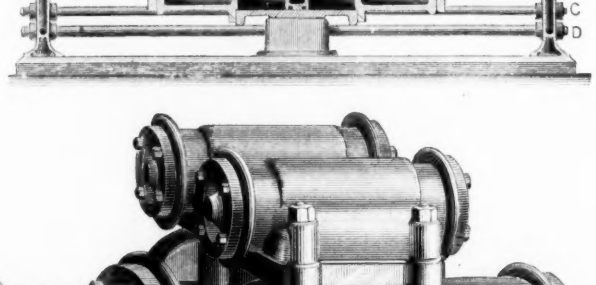
I. P. Wendell, 3,703 Walnut street, Philadelphia, Pa., exhibits an asbestos and graphite compound for journal bearings and step boxes. The composition is acid and fire proof. A test by Goodell & Waters, proved the value of the preparation. A planer cylinder was run by the above firm 5 hours per day for three months at a speed of 4,500 revolutions per minute, without oil. The boxes show no perceptible wear, and the paper packing under the caps has not been hot enough to be discolored.

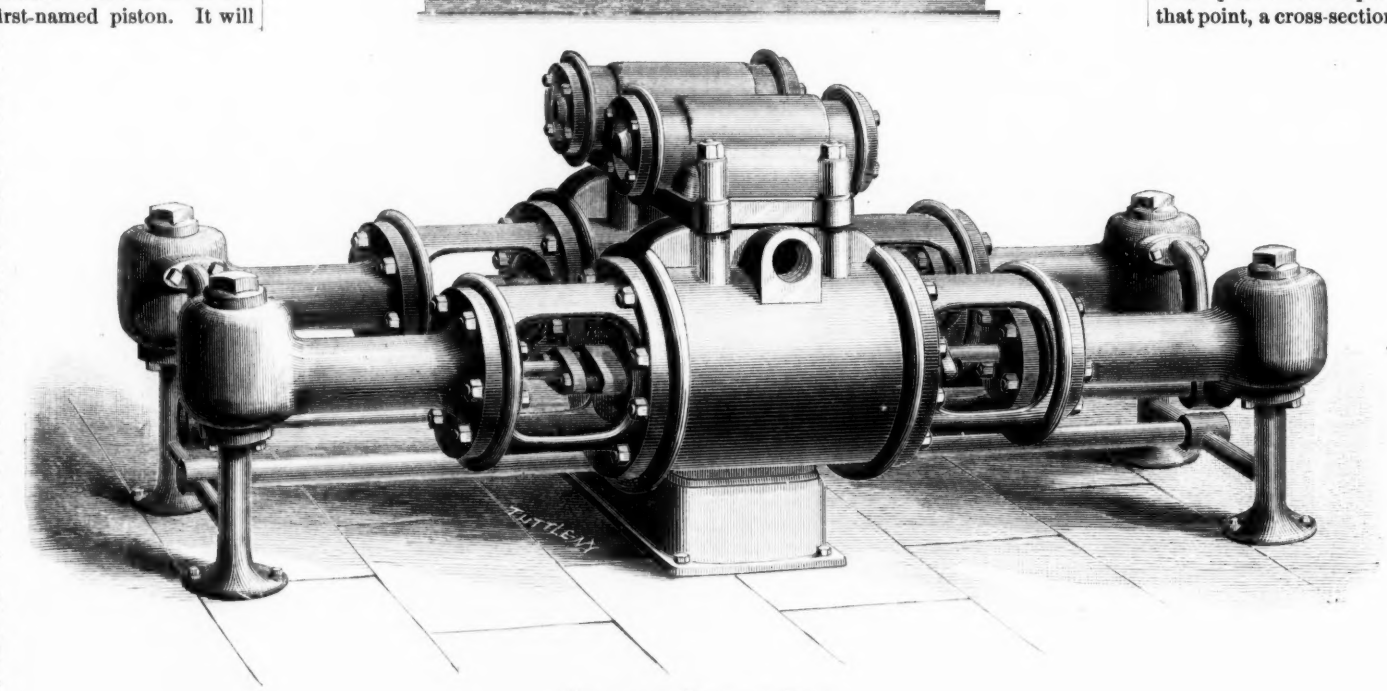
A Trenton automatic cut-off engine $9″ \times 12″$ is running with an $\frac{1}{8}″$ steam pipe, and attracts attention.

The Hall Hydraulic Pressure Pump.

These pumps are specially designed for working hydraulic presses, cranes, testing machines, for use in lead pipe and tool works, etc., etc. They are double-acting with four separate pump cylinders arranged at opposite ends of each steam cylinder, operating in a direct line—the piston-rod and pump plunger at each end being made in one piece. By this arrangement all outside connections, such as crossheads, parallel, connecting rods, guides, etc., are done away with, and the liability to wear out of line, it is claimed, overcome. The relative proportion of piston area, as well as the displacement, is exactly alike at each stroke, consequently there is no variation of the pressure or of the flow. The discharge and suction connections, *C*, *D*, can be made at either or both ends of the pump. The valves and seats can be readily taken out by unscrewing the plug directly above them.

The sectional view represents the interior arrangement of steam valves as applied to this and other forms of the pump. The engine of one division operates the steam valve of the other division, and vice versa. In this view the valve, a plain flat slide, stands at the left of its stroke, in a position to admit steam to the right of the main piston, moving it to the left. When the piston reaches nearly the end of its stroke it passes the port *A*, at the top of cylinder, and a small portion of the steam moving the main piston passes through this port across to, and shifts the valve of the other piston, which then makes its stroke, and in like manner admits steam across to reverse the valve of the first-named piston. It will thus be seen that by proper location of the ports, corresponding to *A* and *B*, in each cylinder, each engine must in its turn make a full stroke before giving steam to reverse the valve of the other. The admission of steam, however, being timed so that each engine starts a little before the other stops, thus keeps up a continuous and uniform delivery of water.





Hydraulic Pressure Pump.

The location of the ports *A* and *B*, near the end of the stroke of the pistons causes each in its turn to pause (while the other is making its stroke) for a length of time sufficient to allow the seating of the pump valves by gravity instead of by the action of the return currents.

It is claimed for these pumps that they occupy little space, are noiseless and positive in operation under any pressure; that they are without working joints and have but few pieces. It is also claimed that the cushion of the pistons is so effective that the entire load against which the pump is working may be thrown off instantly, with full head of steam on, without danger of pistons striking the heads. The workmanship of these pumps is good, all parts being made to gauge and interchangeable.

The manufacturers are the Hall Steam Pump Co., 91 Liberty street, New York.

American bits and augers are in common use by all civilized nations.

It is said that 80,000 dozen monkey-wrenches a year are exported from the United States to Europe.

In recent experiments with a new balloon in France, it is reported to have made headway against the wind, and to have been steered at pleasure.

Early Engineering Reminiscences.

By George Escol Sellers.

Sixteenth Paper.

I propose in this paper and the following one to give some of my own experience of the difficulties early constructive machinists had to contend with, not only for want of effective tools, but in many cases the difficulty in procuring materials for their work; added to this was being obliged to carry out the ideas of higher powers, often against their own convictions of what was right.

In the year 1834, the foundry and machine shops then carried on by my brother and myself, were mostly engaged on work for iron furnaces, rolling-mills, flour-mills and machinery for paper making. To turn the drying cylinders for the latter we, had constructed what at that time was considered a mammoth engine lathe that would turn 9′ in length and 4′ 10″ diameter; also for finishing the housings for paper-press rolls and calenders, we had built and put in operation the first iron planing machine in the State of Pennsylvania. If I recollect right, there were then only two others in the United States, one in West Point, N. Y., shops, and the other in Dr. Nott's Novelty Works. This primitive machine had a capacity for 8′ length by 4′ wide and 3′ high. The bed-plate was driven by screw; the only thing automatic about the machine was reversing the screw to run back the bed-plate at an increased speed. Both the down and cross feed of the tool were by hand. Primitive as this machine was, it did good work, if it did take its time to do it; it was a great advance from the hammer, cold-chisel and file.

In the latter part of the summer of 1834, James Cameron, brother of the Hon. Simon Cameron, at that time chairman of the Board of Canal Commissioners, called on us and said he had been informed by John Brandt that we had the above described lathe and planer, both well adapted for locomotive work, and asked if we would undertake the building of some locomotives for the State railroads. As the paper machinery and other work was slack, we took the subject under consideration, and a few days later I accompanied Mr. Cameron to the shops at Parksburg to see and consult with their engineer, and with Mr. Brandt, foreman of the shops. We rode from the head of the incline plane to the shops on the open platform of the locomotive "Lancaster" (this was before the day of cabs). It was the first engine Mr. M. W. Baldwin had built for the State, and had been but a short time in service. It had a high dome boiler, one pair of driving-wheels back of the fire-box, with half crank-axle and four-wheel truck; the driving-wheels were cast-iron center and spokes with wooden rim or felloes and wrought-iron flange tire. The frame of the engine was wood, cornered and plated with sheet iron; axle-boxes in cast iron slide pedestals with springs for both driving-wheels and truck above the frame of the engine; the cylinders much inclined and placed outside the smoke-box. I have given the description of this engine as it was the type of what the commissioners required, and that what follows may be better understood.

The result of this trip was that we undertook to build some engines for the State road; the commissioners stipulating that the boilers should be dome boilers, one pair of drivers back of the fire-box, and cylinders outside of the smoke-box; drawings to be made and submitted for their approval. Brandt was very pressing that we should undertake to build these engines. He proposed while making the drawings to give me the advantage of what experience he had with the English locomotives, with the Baldwin engine, and one of Norris' that was then having some changes made on it, not having given entire satisfaction, after which it ranked as the most reliable and effective freight engine of its time. Before commencing the drawings I had several discussions with Mr. Brandt, and while making them he several times came down to the city and remained over night with me. It soon became evident that requiring the driving-wheels to be placed back of the fire-box was more due to Mr. Brandt's opposition to full cranks in front of the fire-box, with the cylinders, valves and their connections under the smoke-box, than that urged by the commissioners of unequal distribution of weight and its injurious effect on the rails.

It was also evident that full cranks could not be placed back of the fire-box and the cylinders outside of the smoke-box, without reducing the diameter of the boiler and narrowing the fire-box to an extent that was not admissible.

I proposed outside connections, but that would not be listened to. The Baldwin half crank must be adopted; this we refused without written consent from Mr. Baldwin, which Mr. Cameron undertook to procure, saying they would pay a reasonable consideration for its use. Mr. Cameron returned, saying that Mr. Baldwin had applied for a patent for the half-crank, that he had made the invention for his own protection, and it was not for sale on any terms. In this dilemma I again unsuccessfully urged outside connections. I then proposed to equalize the weight by another pair of drivers back of the fire-box, connected by outside cranks, in the manner of the English four-wheel engines, the front pair of drivers having full crank axle. I made a sketch of this which met with Mr. Cameron's approval, but Mr. Brandt would not give way in his objection to the cylinders with steam connections under the smoke-box—he had so much trouble with the English engines. He finally joined me in advocating outside connections. Mr. Cameron said the commissioners were not willing to risk experiments. I urged that outside connections was no experiment, that Stephenson's Rocket, Hackworth's, in fact most of the early English locomotives were outside-connected. This argument was used against me and its adoption; for, said they, "Stephenson and others would never have abandoned it for full crank unless there had been some radical defect. The fear was that the wide spread cylinders would produce such oscillation as to be injurious to the track if it did not cause the engine to jump it. We offered to build either as I had suggested, with full cranks and two pair of drivers, or outside connections and one pair of drivers back of fire-box; but it was not until we guaranteed against injurious oscillation that the latter plan was accepted. Having reached that point, a cross-section drawing was called for to give the spread of the cylinders, to ascertain if they would pass through the tunnel, as it was being driven on the Lancaster and Harrisburg road, connecting with the State railroad. Supposing all difficulties had been met and overcome, I made the drawings and submitted them, but I was mistaken; my drawings called for an iron frame instead of a wooden one, that up to that time was the only frame in use; it was objected to on the ground of its having too much rigidity. I argued that the boiler was the foundation to build to; that the springs would give all required elasticity. After considerable delay the iron frame was approved of; then arose another difficulty—the diameter of the journals of the driving axle would be the same as that of the axle, the face of the hubs of the driving wheels coming in contact with the brass boxes, would draw the oil from the journal and dissipate it by its centrifugal force, and, consequently, the journals could not be kept from cutting. Various plans were suggested to remedy this imaginary difficulty, one of which was a single collar central to the box, the increased diameter of which would draw the oil towards it; it was not adopted, though Brandt, at that time, was experimenting with it for car axles.

Believing that admitting of inside journals for the drivers carried with it the journals for the truck axles, which brought the truck frame directly under the engine frame, accordingly I made the drawings: a wooden truck frame plated with iron; cast-iron pedestals to carry the axle boxes; a pair of long vibratory springs over the frame, the ends of the springs resting on the axle-box pins. On the center of these springs

were rollers as side bearings for the track between the springs and the iron engine frame. This was objected to, and outside bearings for the truck axles insisted on. As there was no outside wooden frame to place the truck springs over, as in the Baldwin engine, a wooden outside truck frame, with cast-iron pedestals with a separate spring to each journal was adopted. These journals being outside the wheels, they did not come under the frame of the engine. Being satisfied the engine would run more steadily if the front weight was carried on the center of the truck instead of by side bearings on its frames, without consulting the commissioners, we adopted a wrought-iron cradle with a center socket in which rested a steel-faced wrought-iron center pin. As this was the first center-carrying truck ever constructed, I shall, further along, relate the trick we were compelled to resort to, to gain for it even a trial.

Before undertaking to build these engines we had a verbal agreement with Moses Starr, the then only boiler maker in Philadelphia prepared for that kind of work, but by the time the drawings were taken to him, he had contracted to furnish boilers to Baldwin to the full capacity of his shops for some months. Accompanied by Mr. Brandt, I went to New York, and there contracted for two boilers, and even for these the work was divided; the boiler maker not being prepared to bore the flue sheets after turning the flanges, they were bored at the West Point shops.

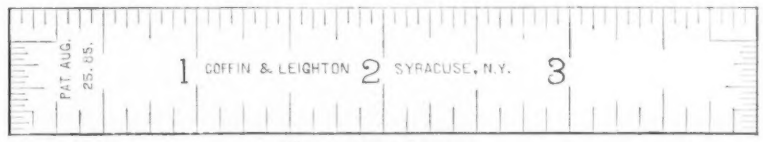
On this trip Mr. Brandt proposed going to Albany to see the locomotive on the Mohawk & Hudson Railroad. When there, we rode on an English four-wheel engine, with full crank axle, wheels about four feet diameter, connected drivers by cranks and rods outside the frame. We also saw in the shops an engine with inclined cylinders placed on the foot-board, four wheels, inside cranks and outside connected. This was shown us as the first successful locomotive run in the State of New York, and was built at the West Point works. We also rode on another engine, built a year or two later at the same works. This was shown as the first four-wheel pivoted truck engine, designed by John B. Jarvis, the chief engineer of the road; it had one pair of driving wheels back of the fire-box. The cylinders were outside of the smoke-box, to give room for the full cranks and connecting rods; the fire-box was narrowed and lengthened. With the exception of the half cranks and dome boiler, this was the type of the engines then building by Baldwin. We also rode on a truck engine built in England from American drawings.

I expected to have found in New York round iron that would finish for 6″ diameter driving axles; also flat iron for the frames, but neither were then kept on hand. We got the frame iron drawn at one of the Pennsylvania charcoal forges, and finished in our own shops. The axles we piled, of charcoal iron, taking the heats in a hollow-fire on an open hearth, and forged under an old-fashioned trip hammer of about 200 lbs. weight. The flange tires we ordered from Lowmoor works, England, giving the outside diameter 4½′, the thickness to be as heavy as they rolled. They came in straight bars so short as to take two bars for each tire, and not exceeding 1⅜″ thick. We had expected to have received them bent and welded. This was another unexpected operation to prepare for, but having good smiths we did not meet with any serious difficulty.

The driving wheels were a subject of much discussion. The rigid manner the road was laid—T-iron secured in cast-iron chairs bolted and leaded to alternate stone blocks and stone cross-ties; intended for an everlasting roadway on which the farmers could haul their produce to market with their own teams at slow speeds; every cast-iron chair on its stone foundation being an anvil on which a quick moving wheel would hammer out the rails; this rigidity of road must be overcome by a certain elasticity in the locomotive; the commissioners seemed to have been carried away by Baldwin's combined wheel center and spokes of cast-iron with deep wooden felloes. This, it was argued, gave the required elasticity. I proposed slightly recessing a cast-iron rim under the tread, letting the tire have its bearing under the flange and about one inch of its outer edge. Objections were raised to this, but led to making the cast rim of the wheel sufficiently deep to admit of recessing to take in well seasoned segments of white oak forming a bottom, and side-supported felloes of about 2″ deep within the rim. These segment-felloes, when secured in place, were turned, leaving just so much fullness that the shrinking tire would compress them and have its bearing on both the wood and the cast-iron rim of the wheel.

The spokes or arms were flat, with ribbed edges. The spans between the spokes opposite the crank-pin, at Mr. Brandt's suggestion, were provided with bosses to receive bolts to secure in place counter-weights which we proposed putting on after the engine was in service. This he did about two years in advance of the Rogers hollow-spoke counter-balanced wheel, which has been frequently referred to as the first effort at counter-balancing. After our wheel patterns were ready for the foundry I became so apprehensive that the wood felloes, subjected to the heat of the tire, after it had shrunk and seated on the iron rims so as to prevent the escape of the gases, would lose their tenacity, in fact, be converted into red charcoal, that I had the core boxes and joints altered, to so narrow the recess for the felloes that the tire would have sufficient bearing on the iron rim, even if the wood was left out; in fact coming to my original proposition of simply recessing; to lessen as much as possible the injurious effects of the confined heated gases on the wood, the holes for the tire-fastening bolts were drilled as escape holes. Years afterwards I was shown a section of one of these tires that had been worn and turned down to about ¾″ in thickness.

It showed a very perceptible setting or sinking into the recess; as to the wooden felloes, I was informed that very little of them was left, and what was, was in loose pieces falling about, the greatest bulk having escaped in dust through a bolt hole.

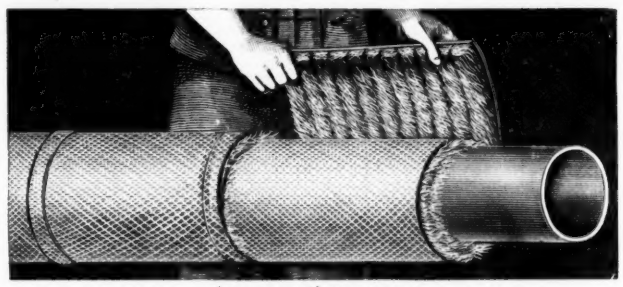


Machinists' Scales.

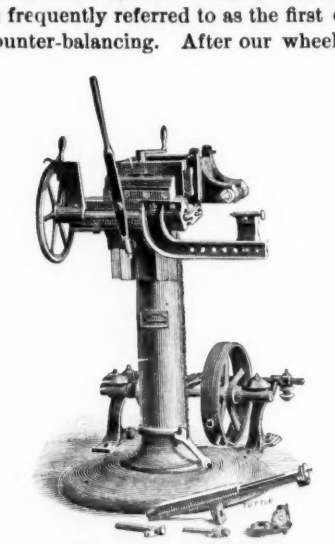
Small Gear Cutter.

This little machine is one of the latest additions to the regular line made by E. E. Garvin & Co., 139 Centre street, New York.

It is intended for rapid and convenient cutting of light gears, ratchets, etc., used in telegraphic and mathematical instruments, etc. It will swing a diameter of six inches on centers, and about twelve inches when the arm which carries the tail center is taken off.



Asbestos Sheathing.



Small Gear Cutter.

The slide has a movement of 5¼ inches between two adjustable stops. There is also adjustment of cutter heads of three inches, allowing the use of finishing and roughing cutter side by side on the arbor, against one stop for roughing cutter, and moved against the other stop for position of finishing cutter. There is also ample vertical screw adjustment for depths of cut in thousandths, and to accommodate varying sizes of work.

There is a large box formed in the top of the machine convenient for holding work, cutters, etc. The cutter spindle can be nicely adjusted to bring the cutter central. A backing-up support for the work is furnished, which prevents chattering and secures smooth cuts in thin flexible gears. The end of index spindle is threaded to admit of using chuck in face-plate for handling work. The indexing is done by means of a pawl, acting on a large ratchet wheel between two adjustable stops.

A rack-cutting attachment, with micrometer adjustment in thousandths of an inch, is shown at the base of the machine in the cut. There will also be seen a bevel-gear fixture, with the necessary adjustments for rolling, in cutting the gear to a center. Countershaft hangers are adjustable and self-oiling.

Engines of war are short-lived now-a-days. Three years ago no praise was too high for the machine-guns which had brought to a close the bombardment of the forts of Alexandria by driving the gunners from the guns they were serving. This week those same guns of Mr. Nordenfeldt's invention are pronounced obsolete, and no longer fulfilling the necessary requirements. Recent experiments carried out in Weymouth Bay by the Polyphemus against dummy torpedo-boats, have shown that the quick-firing gun manufactured by Messrs. Hotchkiss is the only one at present whose results are satisfactory. But Mr. Nordenfeldt cannot complain. He has had a lengthy innings; and it will not be long before the inventor of such a perfect piece of mechanism as the gun which he introduced into the service will have another weapon ready for the defeat of the rival firm.—*London World.*

Flexible Back Hack Saw.

Machinists' Improved Steel Scales.

The engraving represents an improved steel scale, made by Coffin & Leighton, Syracuse, N. Y. The improvement consists in graduating the ends, as plainly shown in the cut. Both ends are graduated, to provide for taking either right or left-hand measurements. By means of this improvement, measurements can readily be taken in grooves, recesses and places where it would be impossible to use the long end of the scale. It will be found very convenient for measuring shoulders on turned work without taking it from the lathe, where the center prevents the use of the ordinary scale.

In other respects, the graduating lines on these scales are clearly and accurately cut, and the general finish is excellent.

Asbestos Corded Sheathing.

The engraving represents this sheathing as made by the H. W. Johns Mfg. Co., 87 Maiden Lane, New York. It is a new production, composed of pure asbestos sheathing, to which is attached, by a fireproof composition, loosely twisted rolls of asbestos fiber, forming material about one-quarter inch thick. It is used as a covering for any heated surfaces, such as furnaces, hot air and smoke pipes, super-heated steam pipes, etc., and as a cushion on light iron for the application of cement felting. It is said by the manufacturers to be the best article yet made by them for the protection of hair when applied to steam pipes.

The Railways of Japan.

All who take an interest in railway extensions will be pleased with the news brought by a recent mail from Japan, relating to the opening of a new railway in that country. The development of the railway system in Japan, is indeed extraordinary; there are at present about 314 miles of railway working and about 800 miles more in course of construction or under survey, which fact will, no doubt, be very gratifying to the contractors, rail makers, rolling stock and engine builders in this country. The cost of construction of the Japanese lines has been abnormally high, especially considering that there have been no preliminary Parliamentary expenses, and that the compensation given for land has been small. Yet, in spite of the heavy first cost, and the fact that the traffic is mostly in passengers, the return for last year, in one section at least, has been very satisfactory. The gross receipts on the Tokio and Yokohama section amounted to 17 per cent. of the total outlay. We hope that the great prospective demand for railway material will be largely supplied by British producers.—*Mechanical World.*

New Flexible Back Hack-Saw.

These saws are of iron, the teeth only being hardened by a process peculiar to their manufacture, which substantially converts the teeth to steel. The back of the saw being soft, it will not break in use; it can be bent to the shape shown in the engraving, then returned to shape again without injury. The teeth at the same time are so hard as to cut with uncommon ease; when dull it is cheaper to throw away the saw and insert a new one in the frame than to sharpen an ordinary saw. Saws of different temper, depending upon the metal to be cut, are furnished. The manufacturers are Henry G. Thompson & Sons, New Haven, Ct., and 51 Leonard street, N. Y.

The old-time item about passing a current of electricity through a steam boiler to prevent scale is again revived.

LETTERS FROM PRACTICAL MEN.

Squaring Mixed Numbers.

Editor American Machinist:

The method given in your last issue for squaring a mixed number is, as given, only applicable when the fraction is $\frac{1}{2}$. The explanation is obvious to any one acquainted with the rudiments of algebra, and a general rule for all mixed numbers is deduced.

If a be a whole number, and b a fraction, then $(a + b)^2 = a^2 + 2ab + b^2$. But $(a + 2b) \times a = a^2 + 2ab$, to which if b^2 be added, we have $a^2 + 2ab + b^2 = (a+b)^2$. Therefore, *to square a mixed number, add to it its fractional part and multiply the resulting number by the whole part of the mixed number; add to the product the square of the fraction.* For instance, to square $4\frac{6}{7}$; $4\frac{6}{7} \times 4 = 19\frac{3}{7}$, add $\frac{9}{49}$ and we have $19\frac{30}{49}$.

This method is an improvement on the one usually employed, and the writer is for one obliged to Mr. Hobart for calling attention to it.

Buffalo, N. Y. GEO. B. SNOW.

[We have received a large number of communications on the above subject much of the same purport as this one.]

Expansion of Gases.

Editor American Machinist:

In connection with your article on superheated steam (Oct. 17th, 1885), and the expansion of gases, permit me to note four special facts that may be derived from information contained in the papers of M. M. Magnus (Poggendorff's Annalen), and Regnault (Ann. Chim. et Phys.); also in Pouillet's Elemens de Physique. They are as follows: That all gases expand nearly alike for equal increments of heat, and that all vapors, when remote from their condensing points, follow the same law; that the rate of expansion is not altered by a change in the state of compression, or elastic force of the gas itself; that the rate of expansion is uniform for all degrees of heat, and that the actual amount of expansion is equal to $\frac{1}{460}$ part of the volume of the gas at 0 degrees Fahr. for each degree of the same scale.

These rules I have verified wherever opportunity has permitted me. To exemplify the expansion, gas expanding $\frac{1}{460}$ part for every degree of additional heat, 460 volumes will expand to 461 volumes for 1 degree of heat, to 492 for 32 degrees, 672 for 212 degrees, and 741 volumes for 281 degrees of heat. With 15 lbs. pressure at 212 degrees an increment of 69 degrees would increase the pressure as 672 is to 741; as 1 to 1.10, or from 15 pounds to 16.50.

In ordinary boiler practice 69 degrees would develop a pressure of 50 lbs. or an increase of 35 lbs., instead of $1\frac{1}{2}$ lbs.

Of course if such superheating apparatus were directly connected (without check valve for instance) the slight increase of pressure developed in the superheater would be somewhat felt in the steam pressure of the boiler. WM. H. WEIGHTMAN.

82 Astor House, New York City.

Licensing Engineers.

Editor American Machinist:

I read the questions for engineers that appeared a short time since in the AMERICAN MACHINIST, and wished something in a similar line were insisted upon in the marine inspection service. If it served no other purpose it would make applicants study further into the principles of engineering, and they would remember more than by reading books on marine engineering.

Licenses are had too easily from the inspection service. I know by observation that they are frequently got through politics, without ability at the back. Sometimes men come from the machine shop with no experience at all as engineers. No one welcomes machinists as engineers more than I do, but for their own good they ought to serve some time in a lower grade than first assistant, even on a 500-ton steamer. They would be all the better for six months in the fire-room. Of what use is an engineer if he does not know how to burn fuel to the best advantage? It is impossible for him to teach others, and he does not *know* that his firemen are doing their duty.

I have no doubt there are engineers who would object to examination being made severer, but at the present time it is too simple, too crude altogether. It permits too many men in the service who do not possess sufficient talent to make good oilers. In a great many instances engineers are to blame for signing their applications; they often do it to oblige a brother engineer, without personally knowing anything about the qualifications of the applicant. This is not justice to any parties concerned. Find out a man's capabilities from his work before signing his application.

I would like to sound a note of warning to stationary engineers, in their efforts to have engineers licensed, that is, that those appointed to grant licenses be men who thoroughly understand their business rather than those who have a political "pull." Don't copy after the marine service, or it will be a curse rather than a blessing.

MARINE.

Improvements in Boiler Construction and Laws Required to Enforce Them.

Editor American Machinist:

In a recent issue of your paper there appeared a letter from Prof. John E. Sweet entitled "Making Tight Boilers Without Caulking," which deserves attention from boiler makers. The matter, is not, however, an original one. I cannot, at present, definitely locate the source from which I first gained the information, but am of the opinion that my attention was called to the subject through the columns of *The Locomotive*, and it made such an impression on my mind from its merit, that since I first read it, I have followed the practice as far as possible, and know other builders of steam boilers who have also introduced the method into their practice, not, however, as a substitute for caulking, but as an aid to accomplish the work without unnecessary strain upon the material.

Improvements of this kind cannot be carried into general effect so long as close competition exists among boiler builders, and such different opinions prevail as to what constitutes the best method of construction.

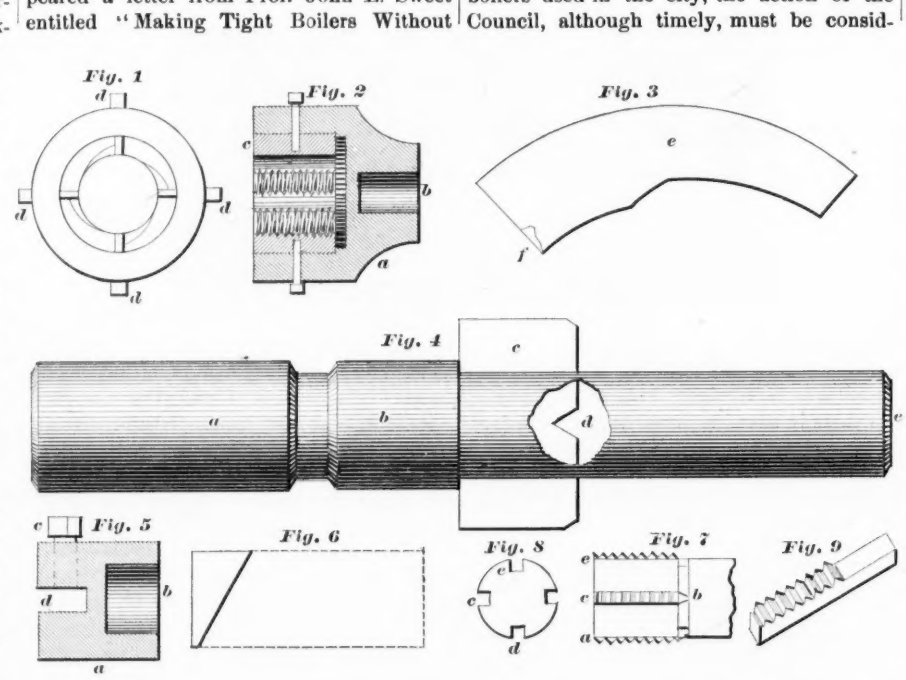
Much can be done by foremen of shops in introducing meritorious methods such as is presented in Prof. Sweet's letter; in this case by laying out the large course on the inner, and small course of shell on outer side of plate, the cylindrical portion of the work can be done as suggested, but when it is understood that in order to fully carry out the idea to the straight seams, it is necessary to turn the plate over on the bench or spacing table, or both, and as this involves an expenditure of labor, which means money, it is hardly to be expected that all shops will carry out to the letter this or any other improvement in construction, unless compelled to do so by wise legislation.

I have previously endeavored to demonstrate the necessity of proper legislation in the manufacture of such an important article as the steam boiler. The greater my experience in their construction, the greater the necessity appears to me for such a measure: and knowing how dependent on steam power we are daily growing, the matter of legal jurisdiction in their manufacture is, to my mind, an absolute necessity.

The statistics of explosions, compiled by insurance companies, demonstrate beyond question, that wherever a regular inspection of boilers takes place, and where they are built under the supervision of inspectors appointed by National, State or City governments, or by companies carrying insurance on their use, the casualties are much less than in those cases where no inspection takes place.

In this (Onondaga) county an explosion occurred on Onondaga Lake in the early part of the summer, resulting in the death of the proprietor of the boat. This explosion stirred up the feelings of the Common Council to such an extent that an inspector was appointed to examine the steamboat boilers plying on the lake prior to May 1st of every year. When it is taken into consideration that but a small percentage of the population enjoy excursions on these steamers, and a large majority are daily exposed to disaster from the greater number of boilers used in the city, the action of the Council, although timely, must be considered as insufficient, in their care of the minority at the risk of the majority, as no ordinance was passed, no charter amendment enacted, authorizing the city authorities to appoint inspectors for stationary boilers. There is a growing sentiment in favor of compulsory inspection of steam boilers, and strict examination of those employed in taking care of them, and it is a question of but a short time when the interests of the people will demand from our law makers such statutes as are necessary to protect innocent lives from the disasters that may be caused by mercenary and unscrupulous builders. The percentage of marine explosions compared with those of stationary boilers, conclusively proves the wisdom of inspection in building, and yearly inspections thereafter. This is also demonstrated in the cities of New York and Brooklyn, where explosions are reduced to the lowest possible point of expectation. The reason of this is obvious, as the inspectors are invested with power to cause the owner of any boiler in their jurisdiction to submit to inspection at stated periods, and repairs must be made in accordance with the requirements of each case and to the satisfaction of the inspector. However much opinions may differ as to the proper method of testing, the fact that inspection protects the property and the lives of the people, is one of the most important factors in demonstrating the urgent necessity of bringing this important subject before our Legislature at its next session. The insurance companies are, or should be, largely interested in this matter, as the laws governing the inspection service in chartered cities where steam boiler inspection is provided for, provides that where parties are insured against damage from boiler explosion, and regular inspection is made by inspectors of such insurance companies, the same may be taken as a regular inspection and exempting the insured from inspection by the local authorities. Conflagrations and destruction of property by fire cause the authorities to revise their charters and reduce their fire limits. Is it necessary that lives in large numbers must be sacrificed before the authorities will take proper steps to protect their citizens? The American Society of Mechanical Engineers, and the National Society of Stationary Engineers should, in my opinion, take active, earnest steps to frame a law acceptable to all interested parties and use such influence as they possess to secure its passage and the appointment of competent educated mechanics (not politicians), to carry the same into effect.

Syracuse, N. Y. GEORGE MARSHALL.



Shop Notes.

A very good way of making dies for cutting pipe threads is shown by Figs. 1 and 2. The cast-iron chuck a is fitted to the spindle, and chambered out to receive the steel ring c. This ring is bored to size, and threaded as required. It is then drilled and tapped to receive the four $\frac{3}{8}$" set screws d, d, d, d. Now, the ring is sawn in two in the center of each hole, and the four pieces are worked down like Fig. 3. The thread is entirely removed to e, and a good cutting angle is given at f, by milling out all that remains of the hole d. When put into the chuck a each screw holds one end of two cutters in place. By finishing holes d by a taper tap, and tapering the set screws, the dies may be held firmly in place. The size may be adjusted for wear, by putting a piece of paper or thin tin between the end f, of the cutter, and the chuck a.

A boring bar was illustrated some time since in the AMERICAN MACHINIST, which closely resembles Fig. 4. The bar a is made of machinery steel, and is threaded for the collar b. It is also slotted to receive the cutter c, and herein is its excellence. At d is a center which is put in by drilling in from the end e. The cutter c is also centered to fit d, and, no matter how carelessly the cutter is put in, it will come true when the collar is screwed up against it.

Fig. 5 shows another handy chuck for a lathe. The malleable casting a has a slot d, planed through it; at b the chuck is fitted to the spindle. A set screw, c, holds the cutter in place.

Fig. 6 shows a cutter which is simply a piece of flat tool steel cut off diagonally from the bar, which is shown by the dotted lines. By bolting a job to the slide-rest, it may be planed up quickly by this cutter. "Hex" bolts, and such shapes may be quickly milled up. This cutter is chiefly designed for brass, but it will work iron in good shape.

Fig. 7 shows a tap to go with the die in Fig. 1. A piece of machinery steel is turned up like a, Figs. 7 and 8. The groove b is turned in, and the slots c, d, e are planed to receive the cutters, one of which is shown by Fig. 9. These cutters are threaded, filed up for clearance, and driven into the slots in Fig. 8. Paper can be used to bring this tool up to size, if necessary.

These tools are used very extensively by the Rue Manufacturing Company, Philadelphia. They were designed by Mr. H. Colvin, and nearly all made by his son, Fred, who is about 18 years of age.

The Pillsburys, of Minneapolis, have just distributed $27,000 among their employes as the total of an annual sum given by the firm. It is understood that this sum is based upon the year's profits and is three per cent. of those profits. If $27,000 is three per cent. the total profit of the year's milling in the Pillsbury mills has been $900,000, a by no means despisable amount.—*The Milling World.*

It is reported that several French and Swiss silk makers contemplate moving their works to this country.

Engine Room Notes.

By James F. Hobart.

"'Taint no place for a man to work," said a lazy chap, who called himself an "engineer." "It's the dirtiest engine-room you ever saw, and the Old Man won't do nothin' to fix it up."

One day he left. The Old Man hired Bob Young to fire and run the engine. Bob had some ideas, and he lost no time in putting them into practice.

There was plenty of lumber around the mill, and Bob put in floor joists around the engine, and laid a neat flooring over the brickbats and dirt heaps.

Bob scraped the engine; he got the dried grease off, and found out who made the machine. The engine-room was sheathed, but it was all dirt, dust and cobwebs.

Bob juggled the painter, got three kinds of paint and painted the walls and ceiling. He got some old steam pipe and made a little railing around the pulley.

One day the Old Man happened in. He looked all around and overhead. Bob wore clean overalls and jacket. There were two or three flower pots in the windows. "Well Bob," said the Old Man, "It looks better, don't it? You go up to the house to-night, and I'll give you a carpet and some pictures and you may order some curtains. Mr. Draper can help you fix up here all you want him to. That other fellow was always pitching into me while he was here, to fix up this engine-room, but what's the use while there's a slouch in it. When I find a chap who is willing to help himself, then I'm ready to meet him more than half way, every time."

And the Old Man was right. One half of the dismal engine rooms might be made presentable, if the men who work in them would take hold and do their best to make and keep them in good order.

An owner don't feel much like finding carpets and paint while the bright work of the engine looks like a soap factory.

Lubricating oils are generally supposed to be entirely safe. Oils of this class, after they leave the hands of the manufacturer, are apt to lose their identity by reason of various mixing processes supposed to improve them. In the cheaper grades the object sought is the cheaper production of an oil that has the appearance of a good lubricant. In the case of a recent fire in a Western flour-mill, the cause was plainly the use of one of these cheap oils. The oils known as the black mineral oils, when of good quality, are adapted for heavy bearings and may be safely used for such purposes, but they are very frequently mixed with light oils of a volatile nature, and there is danger. In the case of the flour-mill cited, an oil of low price had evidently been "compounded" by ignorant or unscrupulous dealers, and the vapors given off, mingling with the dust in the mill, required only ordinarily favorable conditions to cause ignition. In the endeavor to secure lubricating oils at a low cost, consumers do not take into consideration that there may be danger in their use. Mineral oils of good quality, adapted to the work expected of them, are admittedly the safest lubricants that can be produced, but care needs to be taken that those of the best quality are selected. An oil with a low fire test is not fit for lubricating purposes, but such oils are being sold. Some low grades of black summer oils, but little better than tar, have been sold at five and a half cents per gallon, and these, when mixed with light oils to improve their appearance, are sold to the consumer at a price that seems to him low for the quality, while in reality the oil is dear and unsafe.—*American Miller.*

We notice that in different parts of the country workmen, especially in large shops, are in a quiet way organizing societies for mutual help in case of accidents or sickness. When properly put in action, without unnecessary machinery, such societies have a large field for usefulness.

Furnace for Melting Brass.

By Robert E. Masters.

I have been requested by the master of machinery of one of the State universities, to give a sketch of a brass furnace and appliances necessary for melting small quantities of brass to be used in connection with an iron foundry at the university, for the instruction of students in both branches of the art. I offer it through the American Machinist, in hopes that it will be of service to others.

Fig. 1 is a sectional view of a furnace designed for a No. 40 crucible, with a capacity of 120 pounds of brass at a heat. In constructing this furnace the shell was made of bands of cast-iron, each 6″ deep, made from an ordinary pulley pattern; if desired the shell can be made of one piece of light boiler iron, and lined throughout with fire-brick. A slab of cast-iron large enough for the walls to be laid on can be used in the place of brick bottom *A*. A foundation of this kind keeps the furnace from rocking by settling. The plate *B* is $\frac{5}{8}$″ thick, cast in one piece, and is built into the walls at the sides and back, leaving a margin after the furnace is lined up large enough for the grate to rest upon. The top plate *C*, also shown in the plan, Fig. 2, is cast with a bead on the bottom side, to fit around the outside of the shell. This plate is made wide enough, in proportion to the furnace, to allow a man standing room to adjust his tongs on the crucible when ready to lift out and pour. The cover *D* is of cast-iron $\frac{1}{2}$″ thick, with a wrought-iron ring in it. The plate *E* is simply a binder and

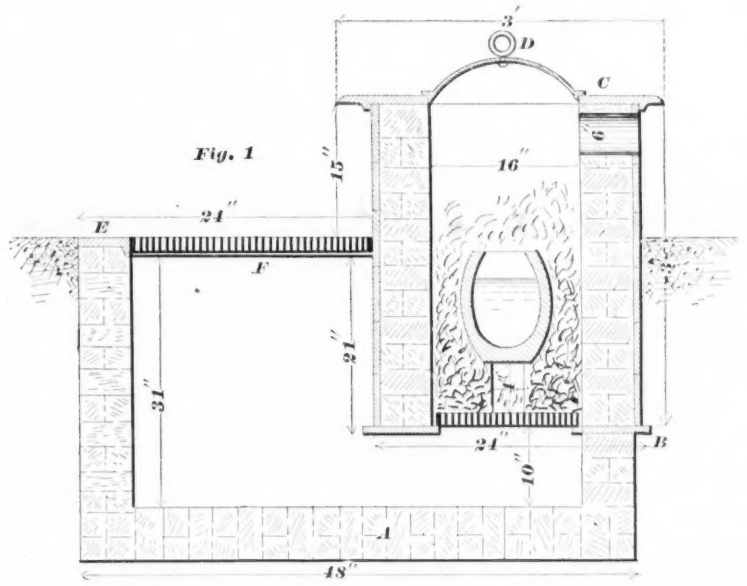


Fig. 1

protection for the top of the wall. The grate *F* can be made in one piece of light open work or in single bars, whichever suits.

Fig. 3 shows the tongs and appliances necessary for lifting the crucible out of the furnace. That portion of the tongs up to the rivet, is made of 2″×$\frac{1}{2}$″ iron, the cross pieces on the tongs of 1$\frac{1}{2}$″×$\frac{5}{8}$″, bent to suit

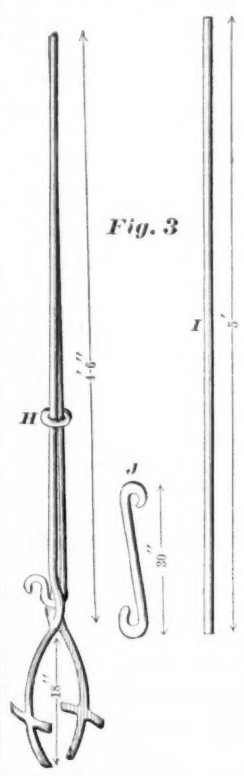
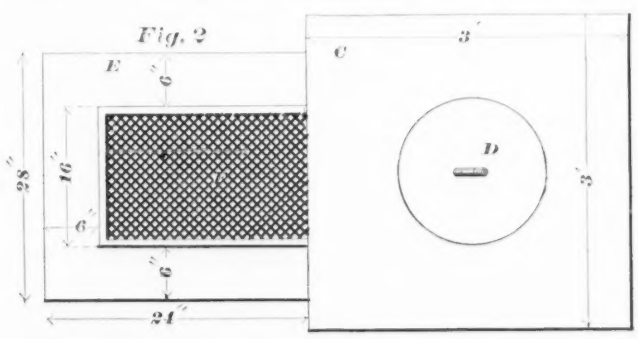


Fig. 3

When ready to lift out the crucible of brass, the tongs are adjusted and the ring *H* slipped down over the handles, the bar *I*, which is 1″ round iron, is put through one end of the *S* hook *J*, and the other end hooked into the hook on the tongs; with a man on each end of the bar it can be lifted out very readily and poured in this position. The man at the tongs, having control of the crucible with one hand, can skim it with the other. Some prefer to use a shank, the same as used in the pouring of ordinary foundry ladles.

One great mistake made by many in building their fire, is, they fill the furnace two-thirds full of coke before setting the crucible in. By pursuing this plan it takes longer to melt a crucible of brass, and in settling down as the coke burns away the moulder is compelled to watch the crucible in order to keep it straight, as it is liable to tip one side or the other. The best plan I have yet employed, both for quick melting and economy in fuel, is to set a piece of fire brick about 4″ thick on the grate, fill the crucible up with old brass (or copper if new metal is to be made), and set it on the brick as shown in Fig. 1, put in the shavings and blocks necessary to start the coke, then fill up with coke to the top of the old crucible;



the circle of the crucible under the bulge. The hook, which is of the same piece as the rivet, is $\frac{5}{8}$″ round iron. The handles of the tongs above the rivet are $\frac{3}{4}$″ round iron. In using tongs made of lighter iron than this, I have found where there would be any difficulty in adjusting them to the crucible in the furnace they would get hot and bend, and not retain a firm grip on the crucible.

this prevents the dirt and coke from getting into the crucible; as the wood burns away, and the coke settles down around the crucible containing the brass, the old crucible can be lifted out. By this plan I have taken off four heats of brass in a day's work of ten hours, using No. 40 crucible, as No. 40 is the size commonly used.

Following are dimensions of crucible, outside measure: Height, 12$\frac{3}{8}$″; diameter at the top, 9$\frac{5}{8}$″; at the bulge, 10$\frac{1}{4}$″; at the bottom, 6$\frac{7}{8}$″; contains 120 pounds of fluid metal. To ascertain the capacity of a crucible, multiply the number of any given size by three. New crucibles should be kept stored in the core oven, or in some warm, dry place. Where they are left exposed, they absorb moisture from the atmosphere, and, on being placed in the furnace, they scale off and crack. After using the crucible, set it back and let it cool off with the furnace.

I add a few mixtures for different classes of work:

PHOSPHOR-BRONZE.

Tough metal for piston rings, linings for eccentric rings, etc., 93 pounds copper, 7 pounds phosphor-tin; for heavy machinery bearings, 85 pounds copper, 15 pounds phosphor-tin.

ORDINARY BRONZE.

Very tough, for eccentric straps, rods, etc., 90 pounds copper, 8 pounds tin, 2 pounds zinc; very hard bronze, 80 pounds copper, 18 pounds tin, 2 pounds zinc.

BRASS.

A good metal for turning and filing is made from 70 pounds copper, 24 pounds zinc, 2 pounds lead; soft yellow brass, 80 pounds copper, 20 pounds zinc.

BABBITT METAL.

Melt 4 pounds of copper; then add 24 pounds of Banca tin, 8 pounds antimony; this composition is called hardening; to each pound of hardening add 2 pounds of Banca tin; this will make the proportions for lining boxes 4 pounds of copper, 8 pounds of antimony, 96 pounds of tin.

Metal that expands in cooling to fill defects in castings, 1 pound bismuth, 9 pounds lead, 3 pounds tin, 2 pounds antimony; this mixture will not do for castings that have to stand fire. A better mixture for that purpose is 1 part gum arabic, 1 part plaster of paris, 1 part black lead, 4 parts iron filings; this mixture is taken bulk for bulk—not in pounds.

The melting points of the metals hereinmentioned are: Copper, 1,996°; antimony, 810°; zinc, 773°; lead, 612°; bismuth, 497°; tin, 442° Fahr. It is worthy of mention here, that in forming the alloys it will be noticed that, while the tin melts at a much lower degree of heat than zinc, it does not vaporize like the latter. When zinc is put in melted copper to form brass, it generates heat enough to vaporize part of the zinc; it should be added shortly before lifting the crucible out, and kept covered with powdered charcoal.

Very little has been written on the mixing and melting of metals for brass castings, and the best method of preparing the moulds, etc. The writer has had considerable experience in making such castings as are used on locomotive and stationary engines in phosphor-bronze, common bronze and brass, but it would be interesting to hear from some competent brass-moulder, through the columns of the American Machinist, on the methods employed in regular brass foundries.

An accident by no means common happened recently on the Pittsburgh and Wheeling division of the Baltimore and Ohio Railroad, near Wheeling. An engine was going over the road light, some distance ahead of a freight train, when the engineer discovered a train approaching on the same track. He immediately reversed his engine, and he and the fireman jumped off. The two engines came together easily, when the light engine started back rapidly and collided with the engine of the freight train, wrecking both engines and severely injuring the engineer, fireman and one brakeman.

The twenty-third annual convention of the Brotherhood of Locomotive Engineers will be held at New Orleans, beginning October 21. The delegates will for the most part have quarters at the St. Charles Hotel.

Our English contemporaries that pay attention to railroad matters are filled with complaints about the long hours railroad men are compelled to work on English railroads.

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NEW YORK, OCTOBER 31, 1885.

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Co-operative Technical Libraries.

We have at different time within the past few years had the pleasure of noting the establishment of shop libraries, but the example set by those who have established them is not so contagious as it ought to be. Such libraries ought to be a part of every shop of sufficient magnitude, and there are very few that are too small. We have never heard that the owners of shops who have got together libraries for the use of workmen have ever regretted it. Access to good books, especially to technical works, cannot fail to have a good effect on workmen in the way of improving them in the line of their work, hence, looked upon as purely a matter of business, the establishment of shop libraries is good policy. This view, we believe, is borne out by all who have had experience in that direction.

Public libraries are generally remarkably free of technical works, or if they possess them, place such restriction on their use as put them out of reach of all but a favored few. The cost of such works is so much that few workmen can afford to own as many of them as they like to consult.

While the proprietors of shops can help themselves and their workmen by providing libraries, the use of which by right—not by sufferance—belongs to the latter, in many instances the men, at a little expense, may do even more to help themselves. Let them move in the matter, and they will be sure of assistance. If, of 100 men working together, each contributes one book, it will be a fair beginning, and it will give every one of them access to 99 more books than he buys. A little talk with the proprietor will, in the majority of instances, develop a place to keep them, and frequently end in large additions to the number. It is a cheap plan for getting the use of the right kind of books, and one that is reasonably sure to succeed. It would be co-operation to a very useful end.

Education Not at Fault.

Much of the discussion of late over the condition of those who, finding themselves with what is popularly called an education, are practically without anything to do, has little point to it. The fact seems to be lost sight of that most people at the present day contrive without much trouble to educate themselves up to the requirements of the positions they occupy, or desire to occupy, and "higher education" by itself, finds little to do. Time was when a man who was able to write legibly had an assured occupation; now most men contrive to do their own writing. In the so-called learned professions there are at least four times as many engaged as are needed, and the same is measurably true in other professions where school education is supposed to play a prominent part. Commenting upon an address on the "Educated Unemployed," by Mr. Rawle, of the Philadelphia bar, the *Evening Post* very truly says:

It [training] cannot either harm or help a man nearly as much as many people imagine. * * * In winning the prizes of life the "personal equation," as it is called, does nine-tenths, the education not over one-tenth of the work. In other words, it is easy to educate a man to earn a bare livelihood, but nobody can be educated to take a seat on the front bench, or be prevented from taking it by any particular kind of education. So that we think it may be safely said to any youth who feels he has the seeds of greatness in him—that is, has the right kind of moral constitution—that it cannot hurt him to go to college, even if he means to be a machinist or a dry goods man, while it is likely to add enormously to the finer pleasures of a prosperous career.

To go a step farther, the fault is not with education, but that people are taught to depend upon it for success, just as they were two hundred years ago when it was rare; taught to depend upon it alone instead of using it as a means to an end. The world is always practical, and never stops to inquire where or how a man became possessed of knowledge it is willing to pay for. The reason why there are so many of the "Educated Unemployed," so many that in some European countries their rapid multiplication is viewed with considerable alarm—is that they do not appreciate the fact that it is necessary to learn to do something useful, using their education as a help in doing so, and furthermore that they cannot all expect to crowd their way into one or two professions already filled three or four times over.

The Explosion at Hell Gate.

The explosion on Oct. 10th of 300,000 pounds of dynamite and rack-a-rock powder in the heart of Flood Rock, at Hell Gate, was the culmination of nine years of work and preparation by General Newton. All this time has been spent in sinking the shaft, driving headings, drilling holes for the cartridges, and otherwise getting ready for the real work of the small fractional part of a minute—blowing to pieces this rock which has always stood a bar and menace to navigation.

Four miles of galleries were cut in the heart of the rock, holes drilled and several thousand cartridges inserted. A few only of the cartridges were connected with the shore by electric wires, the larger part of them being exploded by the concussion caused by the explosion of the few; "sympathy," as it is termed. General Newton's little daughter, twelve years old, pressed the button that brought about the explosion. Nothing approaching this explosion in magnitude was ever attempted before, and General Newton has shown himself an accomplished engineer in this branch of engineering, establishing a precedent that will be of great value hereafter. He is to be congratulated upon his success, and also upon the fact that in all the work attending this gigantic undertaking there has never at any time been even the suspicion of a job, or anything but straightforward, intelligent work in the direction of the end desired. It was a great piece of work, excellently done.

One of the amusing side plays incident to the explosion, was the observations of several scientists made at distances more or less remote from the scene. It was given out that it would occur at exactly eleven o'clock, but for some reason it did not take place until about fifteen minutes later. Notwithstanding this, several experts gave out the results of their observations of the disturbance caused at times varying from a few seconds to a minute past eleven! They had abandoned their instruments before the explosion was brought about.

Unhealthy Shops.

Judging from the accounts published by the Amalgamated Society of Engineers of Great Britain, the sanitary condition of workshops there is much worse than here; in fact, respectable American workmen would refuse to put up with some of the abominable arrangements of the otherwise best shops in England, as pictured by this Society. But this is by no means saying that the attention it deserves is given to the subject of healthy workshops in this country. The contrary is too true, but not to the extent it was a few years ago; there has been progress during the past few years.

Men accustomed to work day after day in shops where the air is seldom renewed, do not notice this condition, nor do proprietors and managers who spend considerable time in the shops, but it frequently strikes those going in from the outside—those who spend but little time in shops—with peculiar force. Well ventilated shops, in which the atmosphere is not full of dust that must be breathed for ten hours by operatives, not only show that the owners have regard for the life and health of workmen, but they are evidence of due regard to the money-making qualities of pure air. Men cannot do a good, honest day's work in poorly-ventilated, foul-smelling rooms; furnishing them with good ventilation, good water and other decent necessary conveniences, will pay large interest on the required investment. These things are cheap; to the owners they mean more and better work and a good deal of satisfaction; to those who live in the shop about half their time, they mean longer life and better health. Some of the modern machine shops in this country are models in respect to sanitary arrangements, and their owners have a just pride in this fact; some of the older ones, if not quite so bad as those noted by the Amalgamated Society, are bad enough to make the subject of improvment in this respect of the first importance. The average life of mechanics working in-doors would be materially lengthened if the sanitary arrangements were as good as they might, with but little trouble and expense, be made. This would be one means, and an important one, to the end of cheaper manufacture.

Literary Notes.

WEST'S MOULDERS' TEXT-BOOK. Being Part II. of "American Foundry Practice," presenting original methods and rules for obtaining good, sound, clean castings; and giving detailed description for making moulds requiring skill and experience. Also containing a practical treatise upon the construction of cranes and cupolas, and the melting of iron and scrap steel in iron foundries. By Thos. D. West, Practical Iron Moulder and Foundry Foreman, Member of the American Society of Mechanical Engineers, and of the Civil Engineers' Club of Cleveland, Ohio. Fully illustrated. New York: John Wiley & Sons, 15 Astor Place.

Those who have read in the American Machinist the contributions of the author of this work on matters pertaining to foundry practice will not need to be told that the present book is written in such a manner as to be comprehended by any one who can read the English language. Another valuable feature of the writings of Mr. West is the minuteness with which he describes details, leaving nothing important to be assumed or guessed at. When men are masters of the business or trade about which they write, their writings very frequently convey the impression that they believe those for whom they write will object to reading details with which they might be presumed to be acquainted. This often makes a book substantially worthless, except for those well advanced in the business or trade treated; and even for such, some of the matter will be of no value, because sufficient attention is not given to detail. The author of the "Moulders' Text-Book" does not make this mistake. His presentation of the subject is always so complete as to be understood by the beginner, and this is exactly what the more advanced reader, who has but little time to study for hidden meaning, appreciates.

As stated in the title page, the present work is intended as Part II. of "American Foundry Practice," published some two years ago. It contains 460 pages, and the matter is equally as good as that of the first volume—in fact, we think better, if possible. A portion of the work is made up from articles prepared by the author for the American Machinist, these articles having been revised and added to. Other parts of the book have never been published before.

Space will not permit entering into a detailed sketch of the matter treated in this work. In this respect, it must suffice to say that the subjects are such as interest alike the moulder doing the work and the proprietor for whom it is being done. We make two exceptions to the intention not to mention details. One is in the instance of the division under the head, "American Cupola Practice." In this division, forty-six reports of the working of cupolas are given, the cupolas being in thirty States. In these, complete dimensions of the cupolas, size and speed of blowers, time of starting fires, charging iron and coal, time of melting, iron melted and fuel used, and other particulars are noted. The information contained in this division has never before been given, except in isolated cases, and is alone worth several times the price of the book.

The second exception is in the instance of the division, "Foundry Cranes." But little has been published on this subject, and what the author gives from experience will doubtless be appreciated.

Useful tables, many of them original, appear in the work. Altogether, the book is one that every moulder, and every one interested in such matters, should possess. The price is $2.50.

We learn that fluor spar, which has been used in this country for some years past as a foundry flux, and for other purposes, has recently been successfully used in Europe in the manufacture of steel by the basic process, and is likely to be employed in large quantities for this purpose. As yet we believe no experiments have been tried in this country looking to the use of fluor spar in basic steel-making. A difficulty which some foundrymen have met with in using the article, has been due to the fact that they use it in excess. We have heard of instances in which as large a quantity as 50 lbs. to the ton of iron has been attempted. Only 8 to 10 lbs. to the ton of iron is required.

In our issue of Oct. 17, in describing a pipe cutting and threading machine, we inadvertently gave one of the addresses of the manufacturers, Forbes & Curtis, as 98 John street, New York. This was a mistake. Their address is 98 John street, Bridgeport, Conn.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(300) **C. S——** will find directions for making blue prints in the AMERICAN MACHINIST of May 28 and October 8, 1881.

(301) **J. J. B.** and others should read the requirement as to giving name and address at the head of Questions and Answers.

(302) **E. E, San Luis, Obispo, Cal., asks:** What is the horse-power of an engine 7½″×10″, 220 revolutions, 90 lbs. boiler pressure? *A.*—At this boiler pressure you ought to get a mean effective pressure of 45 lbs.; the piston speed is 366 feet; area of piston, 44 inches; hence, on this assumption, the indicated horse-power would be

$$\frac{44\times45\times366}{33000} = 22.$$

(303) **Fireman, Hageman's Mills, N. Y.,** writes: In making boiler tests, I notice that the average temperature of feed water is taken, then weight of water evaporated, then equivalent evaporation from and at 212°. How is this figured out? *A.*—You will find in the AMERICAN MACHINIST of October 18, 1884, an article on this subject, with a table of factors, by the aid of which you can very easily solve such problems.

(304) **G. W. D., Rochester, N. Y., asks:** 1. What would be the horse-power required to drive a two-blade propeller wheel, 15″ diameter and 22″ pitch, fully submerged, at a speed of 425 revolutions per minute, the wheel to be bronze, and as smooth as practicable to make? *A.*—You cannot make anything like exact calculations. Parties who are accustomed to making small boats can, from their experience with wheels of certain dimensions, give you a fair idea. We do not know of any other way you can get the information. 2. In driving a 22-foot boat, 4 feet beam, of fairly good lines, loaded to a draft 18″ aft and 10″ forward, would the slip of screw be more than 10 per cent? *A.*—Probably not less than 20 per cent.; very likely more. 3. Would it be considered practicable to drive a boat of this size, and under the above conditions, at a speed greater than eight miles per hour for twenty or thirty miles? *A.*—We should say that, under the above conditions, you would not get a speed of more than six miles per hour; higher speed would require more turns.

(305) **L. K., New York, writes:** I want to put an injector on a boiler; the injector has no check valve in overflow, so that each time it is put at work a quantity of air will be carried into the boiler. Now, what I should like to know is, what effect this will have on the coal required? Will the air, expanding by heat, create a pressure on the gauge, so as to deceive the engineer in regard to the real steam pressure in the boiler? What will be the influence of this air on the working of a non condensing engine? *A.*—You will not be able to detect any influence on the steam gauge from what air will be injected in this way. It is the opinion of some engineers that forcing a little air in the boiler along with the water helps to keep a boiler clean, and they make provision for doing so. Air in the steam will help to move the piston; there are various arrangements for using air with the steam, but they have so far not come to much. If a considerable quantity of air is forced into the boiler, it will expand by heat, and materially increase the pressure. There will be no bad influence felt in the engine.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

T. M. Parker, Steel Stamps, Stencils, Hart'f'd, Ct

J. Clayton, Air Compressors, Rock Drills 43 Dey st, NY

Edw. Sears, wood engraver, 48 Beekman st., N.Y.

Steel Name Stamps, &c. J.B. Roney, Lynn, Mass.

Pat attorney and expert. Machines designed and detailed. Wm. H. Weightman, 82 Astor House, N.Y.

Consulting Engineer and Mechanical Expert, C. C. Hill. 84 Market st., Chicago, Ill.

Tack, Wire, and Shoe Nail Machinery; Wm. A. Sweetser, Brockton, Mass.

Treatise on gear teeth and bevel gears; specimen pp. free. Geo. B. Grant, 66 Beverly st., Boston, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John st., N. Y.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st, New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Selden Packing for stuffing box, with or without rubber core Randolph Brandt, 38 Cortlandt st., N.Y.

Improved Labor-Saving Upright Drills: prices reasonable. Currier & Snyder, Worcester, Mass.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Foot-Power Machinery for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to lay out gear teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Machines to form and bend steel and iron; run by power. Williams, White & Co., Moline, Ill.

Tack and Wire Nail Machinery, made by the Wilets Mfg. Co., Providence, R. I.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Oct. 10 p. 14. Send for circular No. 17, Curtis Reg. Co., Boston, Mass.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham st., N. Y.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co, Collinsville, Conn.

The outline ("wax process") engravings shown in the AM. MACHINIST each week are made by Struthers, Servoss & Co., 24 to 34 New Chambers St., N.Y.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-Taught;" $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Kellam's Pressure Regulator—used in heating system of 11-story building, Madison ave., N. Y.,—saved, last season, $2,000 over previous season. Hine & Robertson, 12 Cortlandt street, New York.

Locomotive Engine Running and Management. By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air brake explained by aid of engravings. Price, $2. For sale by *National Car Builder*, 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES

Waterloo, N. J., wants water-works.

There is talk of water-works at Camden, N. C.

South Easton, Pa., is agitating the construction of water-works.

It has been about concluded to construct water-works at Bristol, Tenn.

The Columbus Oil Co., Columbus, Ga., are building a barrel factory.

Green Bros. will build a 3-story hat factory, 28x100 feet, at Danbury, Conn.

W. G. White is President of a new flouring mill company in Birmingham, Ala.

Oliver Weisel and J. E. Du Bois will erect a chain factory at Birmingham, Ala.

A flour and corn mill is to be built at Palestine, Texas, by A. B. Williamson.

Spang, Chalfant & Co., Pittsburgh, Pa., are erecting an addition to their gas and pipe mill.

The North Star Flour Mill, Sand Beach, Mich., recently destroyed by fire, is to be rebuilt.

The Dunnell Manufacturing Company, print works, will erect an addition to their works 272×64 feet.

W. L. Shideler, of Wilmington, O., has organized a company at Birmingham, Ala., for the manufacture of bridges.

J. T. Dodson, of St Louis, Mo., will soon begin the manufacture of fish bars and lock nuts at Birmingham, Ala.

Benjamin Buckley's Sons, Paterson, N. J., have recently put in a 200-pound Beaudry upright hammer for forging flyers.

The West Virginia and Central Pittsburgh Railroad will erect car and repair shops and a round house at Davis, West Va.

Weisel & Vilter, Wilwaukee, Wis., will add a new department to their machine shops to manufacture German Sewing Machines.

The Mt. Joy, Pa., Steam Heating and Boiler Company have leased additional buildings for the purpose of increasing their output.

George W. Hayes has surveyed a piece of ground at Lickdale, Pa., for the erection of an iron plant. Sheet iron will be manufactured.

A large iron furnace is about to be built near Bellefonte, Pa. Capital stock, $1,000,000. For particulars, address General J. A. Beaver, of Bellefonte.

Ellis, Converse & Co., woolen manufacturers at Stafford, Conn., are building quite a large addition to their mill, into which they will put additional machinery.

The Pennsylvania Steel Company, Steelton, Pa., are manufacturing an electric crossing signal for railroads, which is highly spoken of, especially for isolated crossings.

Col. Harry McCormick, South Harrison, Pa., has broken ground, near his present mills, for the erection of works to be used in the business of converting iron into steel.

John Gray, 272 Ryerson street, will erect a four-story brick factory building on Ryerson street, near Flushing avenue, Brooklyn, N. Y. John A. Hanlon is architect and Chas. Collins, builder.

Mrs. Claus Lipsius will erect a five-story brewery on Garden street, near Bushwick avenue, Brooklyn. Th. Englehardt is the architect, and the builders are John Rueger and Jacob Rauth.

The Straight Line Engine Company, Syracuse, N. Y., write us that during the past few weeks their sales of steam engines have been larger than for the same time since commencing business.

Plans have been filed for a two-story brick and iron front factory, to be erected at 609 W. 52d st., New York City. Estimated cost, $1,500. Owner, Wm. M. May, 609 W. 52d st.; architects, Wilson & Hudson, 490 6th ave.

D. Saunders' Sons, extensive manufacturers of pipe-cutting and threading machines of all kinds, at Yonkers, N. Y., say that sales for the last month have been very good, showing great improvement over any month's business for the past year.

The Edison Light Company, of Jackson, Mich., have everything in readiness to double their plant, and, having secured the city contract for twenty arc lights, they will set two new dynamos of 40-light power.

A company, known as the National Lubricator Company, has been incorporated at Chicago, Ill., to manufacture a lubricator for car axles. E. F. Mulloy, C. H. Koch and G. A. Woolley, incorporators.

King & Co., Winchester, Ky., write us in reference to a previous mention of their enterprise; "We are erecting a machine shop for general repairing and building, and hope to erect a foundry in a short time."

Lacy & Son, tobacco manufacturers at Wright City, Mo., with Mason, a manufacturer at Foristell, propose to establish a tobacco factory, employing 100 hands, at Mexico, Mo, if a bonus of $2,000 be given them.

The Duplex Press Company have commenced work at Battle Creek, Mich. They manufacture double printing presses—those that print both sides of a paper at once—and employ fifty machinists from the start.

Walter B. Guild, of 27 Kilby street, Boston, Mass., is starting a small machine shop for the manufacture of fine weighing scales and other patented specialties, and expects to be in the market for a small amount of machinery soon.

T. H. Dallett & Co., manufacturers of portable drilling machines, formerly located at No. 8 North Twenty-first street, are now established at 3013 Chestnut street, Philadelphia. They have recently added a Brown & Sharpe grinding machine to their plant.

A three-story brick building, to be used as a carpet factory, will be erected on the east side of Orianna st., between York and Cumberland sts., Philadelphia. Work commenced 8th of October. Estimated cost, $10,000. D. C. Schuler, 2,263 Fairhill, st., Philadelphia.

A press dispatch from Omaha, Neb., under date October 13th, says twenty acres of ground were purchased near the city limits of that city four days previously, for shops, roundhouse and other terminal facilities, for the Nebraska extension of the Missouri Pacific Railroad system.

The Monson Water-Power Company, office at Portland, Maine, has bought about 1,200 acres of timber land, and the water-power at Monson, Maine, and propose to establish a large lumber business. It is also the intention of the company to improve the water-power, and let it to parties desirous of entering into manufacture of other kinds.

As an evidence of the extreme depression existing in Boston business circles, so feelingly described by the *Transcript*, we may mention that the Amoskeag Company is about to add to its immense property by the building of another mill which will cost about $1,000,000.—*Boston Commercial Bulletin.*

The most important new enterprise in the South is that for the erection of immense works in Virginia at a cost of $2,250,000 to manufacture steel composite brass, etc., the annual capacity to be 100,000 tons. The purchase of 18,000 acres of magnificent coal and iron land has already been made.—*Boston Commercial Bulletin.*

Prof. Charles J. King, of the Wisconsin State University, Madison, Wis., says the new foundry in course of erection at the university will be thirty feet square.

C. B. Price, superintendent of the River division of the Allegheny Valley Railroad, has invented a device for obtaining a "frogless main track." He prefers to erect a manufactory at Pittsburgh, but has offers from Chicago, Philadelphia and Harrisburg. It is said that Andrew Carnegie holds a half interest in the foreign patents.—*The Railway Review.*

The Fort Wayne Iron Works, at Fort Wayne Ind., have resumed operations after a shutdown of four months, induced by the failure of C. L. Olds & Co. in February last. The company have nearly $50,000 worth of patterns, covering tan-burning furnaces, bark conveyors, hide mills, etc. They also make boilers, engines and castings of all kinds.

John H. McGraw, 187 West Eighth street, Oswego, N. Y., whose adjustable tube expander was illustrated in the AMERICAN MACHINIST of June 13 last, writes us: "I had anticipated the year 1885 would be dull and concluded to go slow, but have sold these tools to some of the leading firms in the United States, and they are all so well pleased that some of the firms, after using, have ordered a complete set."

A member of the Sand Blast File Sharpening Co., Wilmington, Del., writes us claiming that a shop requiring the services of four filers, can make an estimated saving of $714.56 annually, by the use of the sand-blast process for sharpening files. He adds: "Many of the files can be re-sharpened three times, and we have known single-cut 12″ files used on lathe work to do over five times the work of new files not sand-blasted. A hollow file can be ground flat or rounding with very little trouble, and in this way saved for good work."

We have received from the Dickson Manufacturing Company, Scranton, Pa., and 112 Liberty street, New York, four elegantly-bound, printed and illustrated catalogues of machines and machinery, manufactured by them. One of these relates to "Standard Gauge Locomotives;" another to "Narrow Gauge Locomotives;" the third to "Hoisting Engines and General Mining Machinery," and the fourth to "Machinery for the Transmission of Power." The books are valuable for reference, and clearly set forth the complete line of manufacture in which this company is engaged.

An election was held in Vicksburg, Miss., on October 6, to vote on a proposition of the Louisville, New Orleans and Texas Railroad Company, in which it is agreed by the company to locate and maintain its general repair and machine shops in that city, provided that the city exempt all property of the company from taxation for 99 years, and vote, in addition, bonds to the amount of $100,000. The law requires that two-thirds of the votes polled should be for the proposition. The result was: For the proposition, 1,693; against, 210. It is believed this action secures beyond further question the location of the railroad shops at that point.

At a special meeting of the directors of the Globe Yarn Mill, Fall River, held last week, it was decided to call a meeting of the stockholders, during the month, to vote on the proposed increase of plant by the addition of a new mill. If the stockholders vote to make the proposed increase, the directors will make contracts this fall for machinery and building materials. It is proposed to locate the new mill on the site already owned by the corporation, west of the present site of the mill, and to make it of about the same size, 80×318 feet. The Globe Yarn Mills were incorporated in 1881, and have been in operation a little more than two years.—*Manufacturers' Gazette.*

Wm. H. Brundige writes us from Gadsden, Ala., "I am now laying the mains for the Gadsden water-works; nearly 7 miles of mains to be laid, of 10″, 8″, 6″ and 4″ cast-iron pipe, and 50 fire hydrants. Works will be completed by December 1, 1885. Then I go to Selma, Ala., to build the works there. The whole South seems to be on a boom on water-works, and, in fact, all kinds of buildings are going on. The South is the place for any good mechanic. I have been South for 6 months; came from Maryland. I am working both black and white. Large crops are being made in the South, and everybody seems to have money and to be happy. A large rolling mill is being built at Anniston, Ala., and will be started December 1, 1885, by Noble Bros.; also a large cotton compress nearly completed by Comer & Trapp."

Ground has been broken for the erection of a worsted mill in connection with the Globe Woolen Mills in West Utica. It is to be a brick building 60×204 feet on the ground, and four stories high. Each of the four stories will be 14 feet high. There will be a staircase tower on the northwest corner, and an elevator tower in the rear. The rough floors will be of 4¼-inch Norway pine, and on these a surface floor of 1¼-inch match spruce will be laid. The roof will be covered with three-inch plank on which a regular asphalt roof will be laid. The windows will be of double thick glass. Only the foundation will be built and the floor of the first story laid this fall. The work will then be covered over and left in such shape that it can be resumed next spring. The building will then be finished, and in addition an engine house 24×60, and a boiler house 46×60 feet, each one story high, will be built. A chimney will also be built 120 feet high. An engine of 300 horse-power will be put in, and the new factory when completed will employ from 150 to 200 hands.—*Commercial Bulletin.*

The Globe Yarn Mill Company, of Fall River, Conn., propose to erect a new mill. Arnold B. Sanford is treasurer.

Skinner & Arnold's boiler shops in Albany, N. Y., recently destroyed by fire, will be rebuilt immediately. Cost, $50,000.

The Allen Paper Car Wheel Company increased its business for August and September 100 per cent. —lacking only ten wheels.

The Globe Knitting Company, Amsterdam, N. Y., has been incorporated to manufacture knit goods Capital stock, $150,000. Incorporators, H. S. Ward, Jepther R. Kiddes and Thomas B. Lawson, all of Amsterdam.

Machinists' Supplies and Iron.

NEW YORK, Oct. 15, 1885

There is no change worth noting in the supply business since our last report. General business has decidedly improved, and in supplies and manufacturing this is being felt. Our reports from manufacturers show in many instances materially better business for the past few months; in other instances, as a matter of course, the improvement has not been felt. On an average, the prospects have been and are encouraging.

Iron—In American pig the market is quiet, but steady. Sellers show no disposition to make concessions, but buyers generally are taking small lots only. We quote No. 1 X Foundry, $18 to $18.50 for standard brands; No. 2 X Foundry, $16 to $16.50; Grey Forge, $13.50 to $14.50.

Scotch Pig—There have been but few sales of small lots. The Glasgow market has been a trifle easier, but this has not had much effect here. We quote Coltness, $19.50 to $20; Glengarnock, $18.50 to $19; Gartsherrie, $19 to $19.50; Summerlee, $19 to $19.50; Eglinton, $17.50 to $18; Langloan, $19.50; Dalmellington, $18 to $18.25.

Lead—The market is a little easier, and dealers less confident in their ability to maintain prices. Sales have been made at 4¼c., but 4.15c. is asked.

Copper—The demand shows no decided improvement. Asking prices for Lake are 11c. to 11⅛c., but sales have been made at slight concessions. Other brands are held at 10⅝c. to 10¾c

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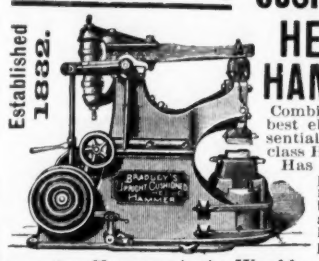
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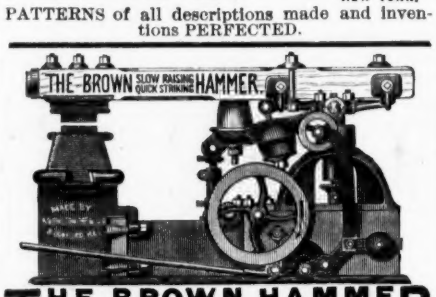

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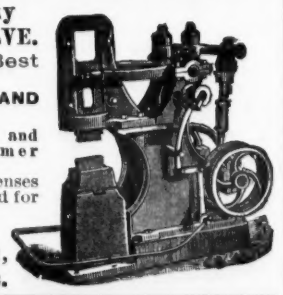
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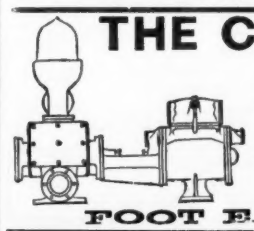
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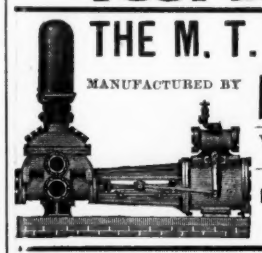
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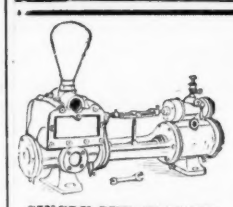
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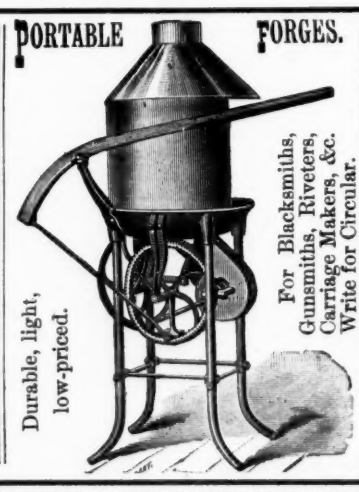
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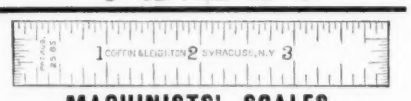

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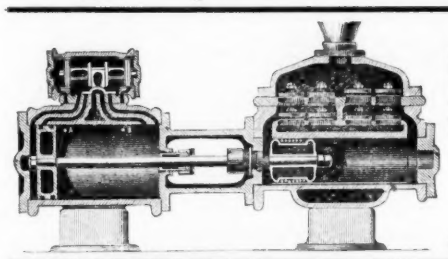

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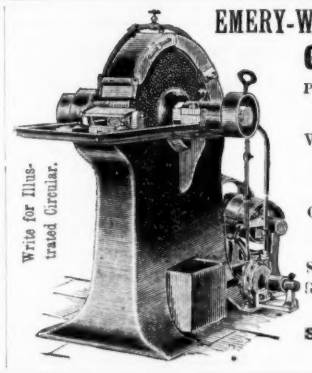

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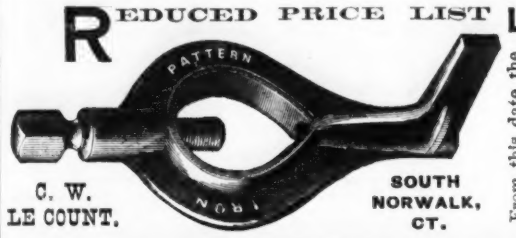

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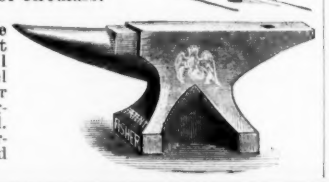

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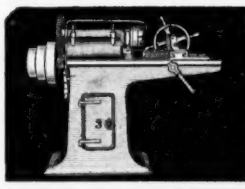

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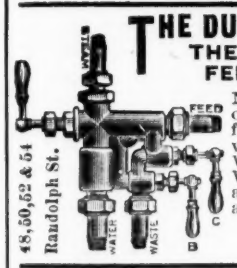

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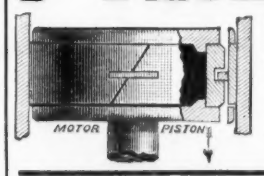

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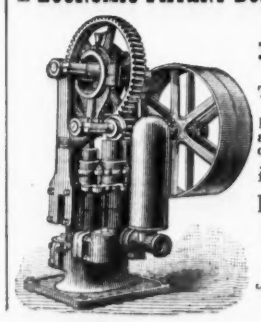

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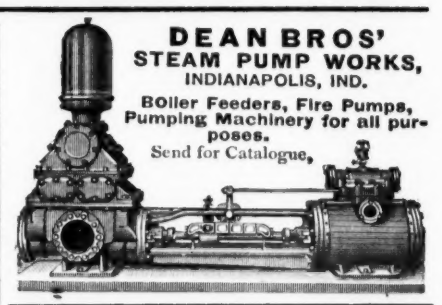

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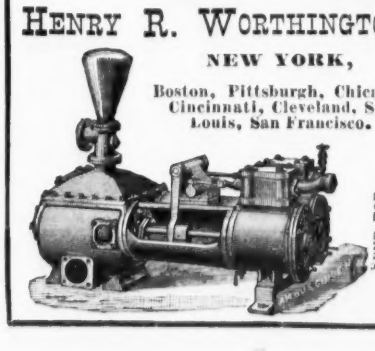

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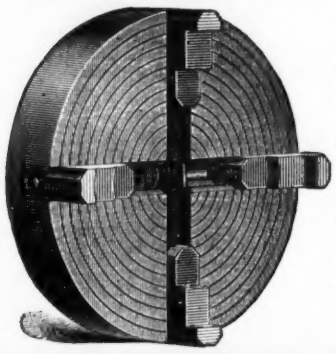

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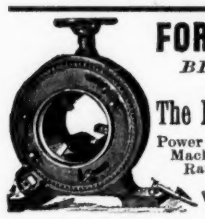

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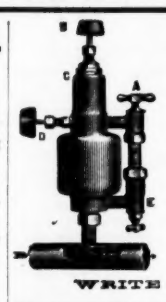

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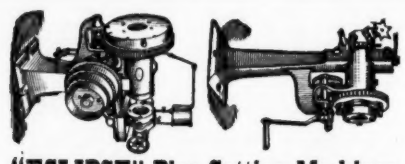

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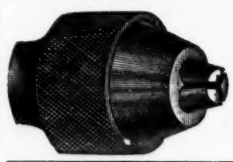

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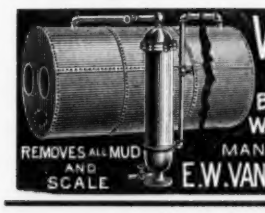

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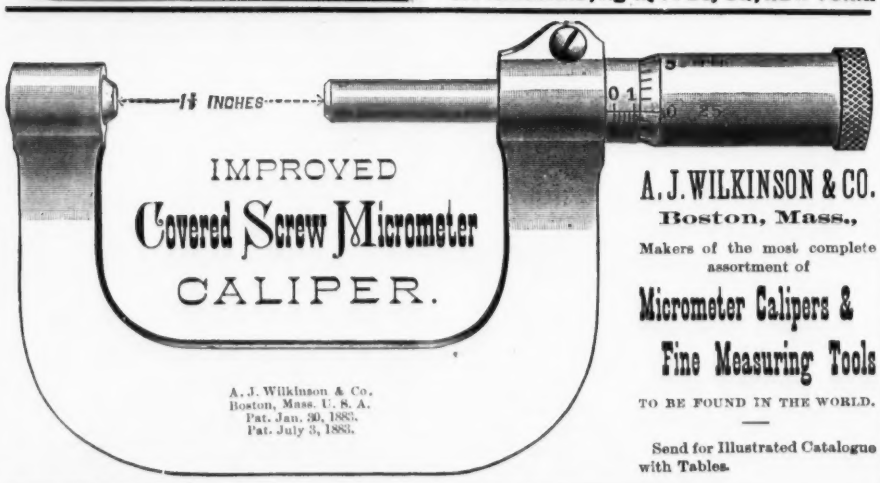

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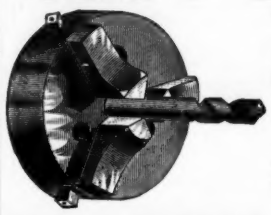

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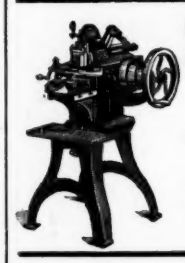

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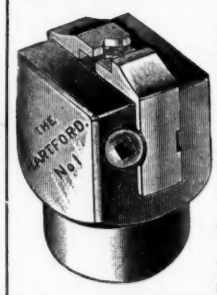

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NOTICE.

Week before last we published, under this heading, references to a small portion of the practical articles that have been specially prepared for the American Machinist, and have appeared in our columns during the last few months. Last week we published an additional list. We append another list below. No other mechanical journal in this country has or ever has had such a collection of practical articles, by writers of well known ability, as are presented in these columns week by week. Every issue gives information that is taken up and applied in the shops and factories in various parts of the country. Copies containing these articles can be readily obtained by ordering of any newsdealer, or by writing to this office, at 5 cents per copy.

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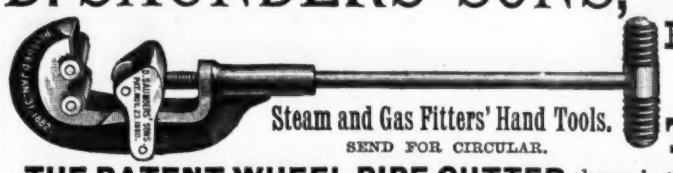

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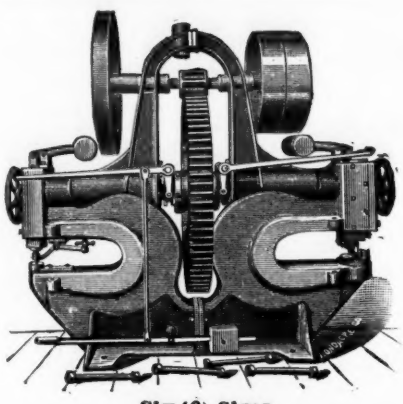

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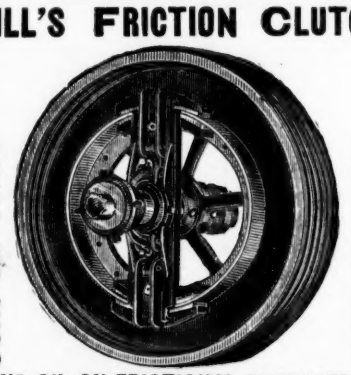

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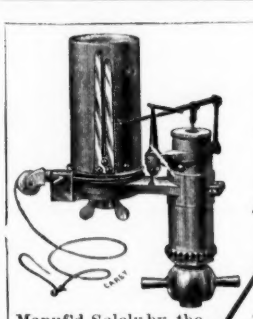

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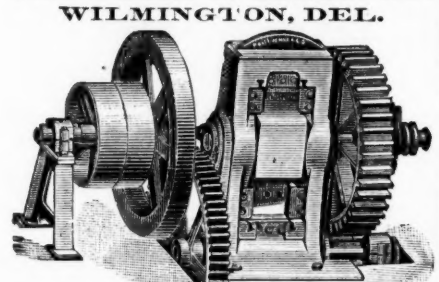

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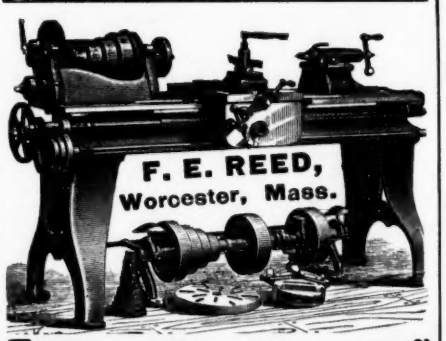

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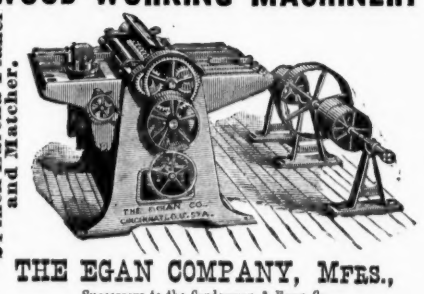

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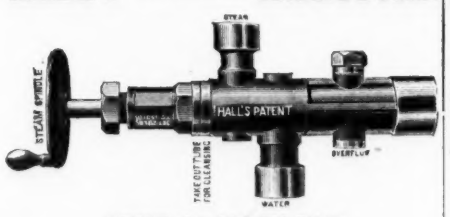

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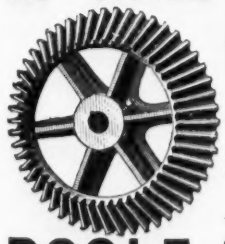

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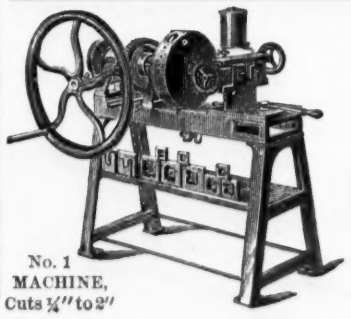

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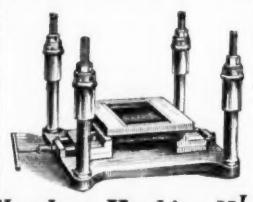

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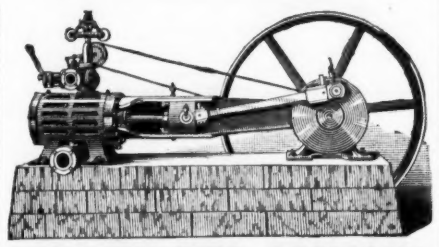

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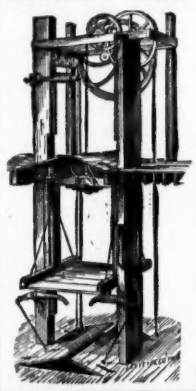

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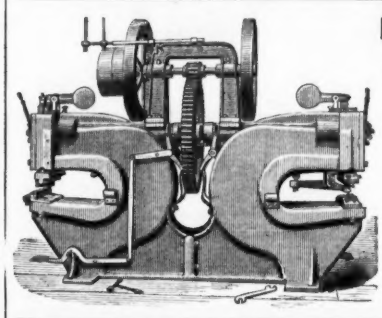

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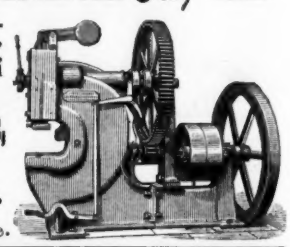

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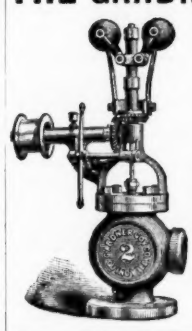

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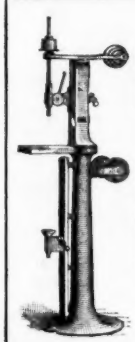

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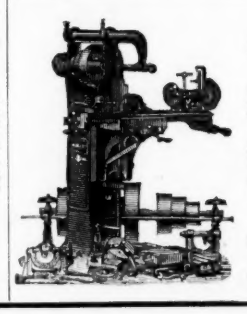

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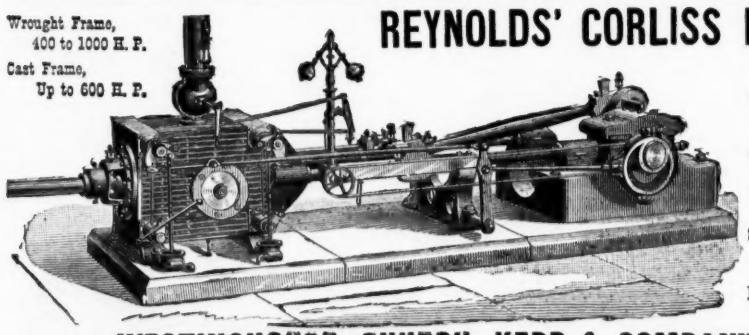

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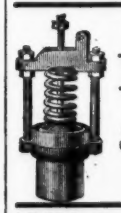

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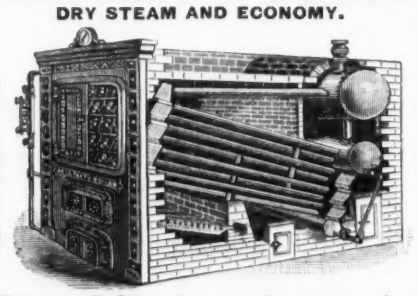

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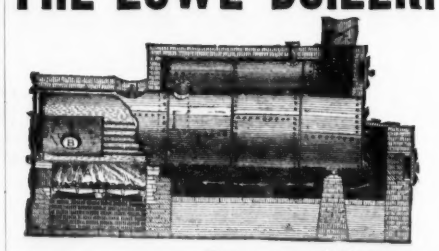

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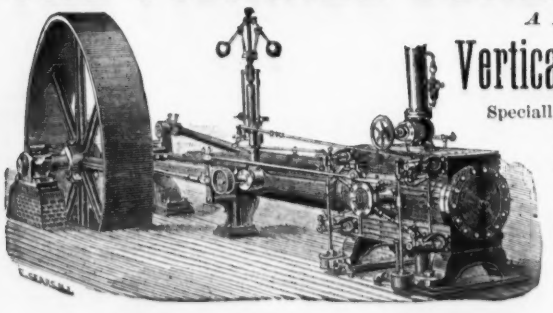

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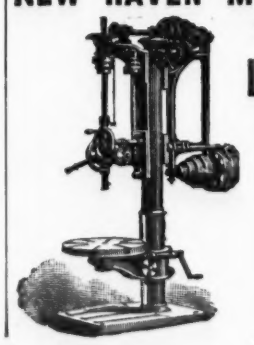

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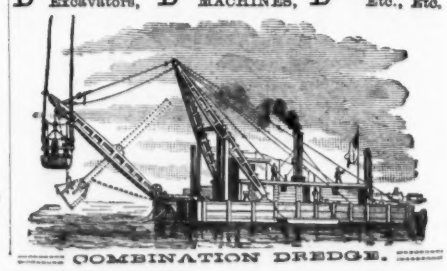

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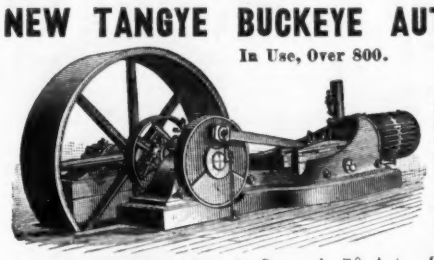

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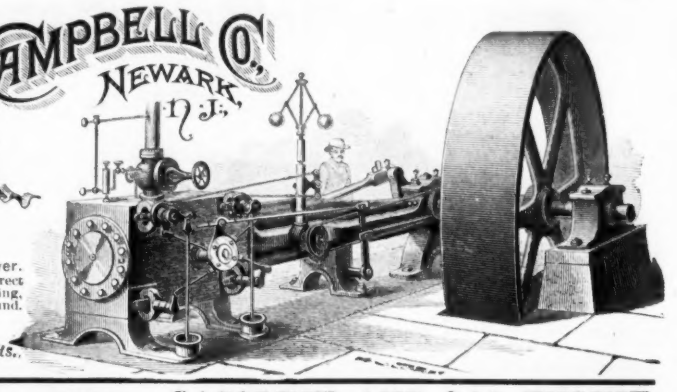

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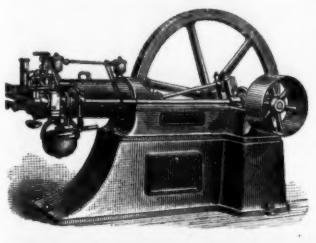

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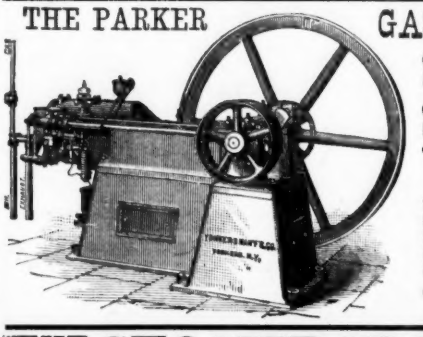

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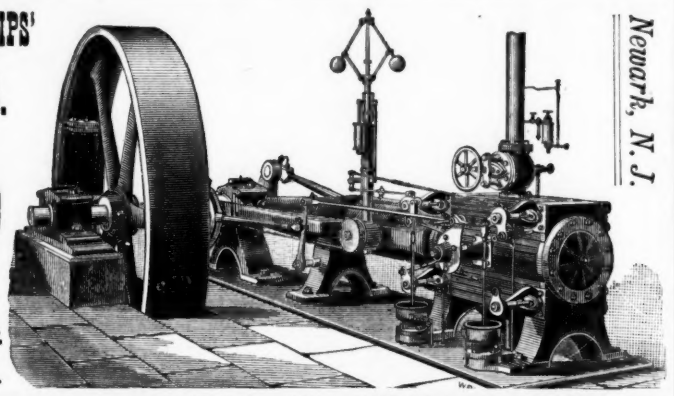

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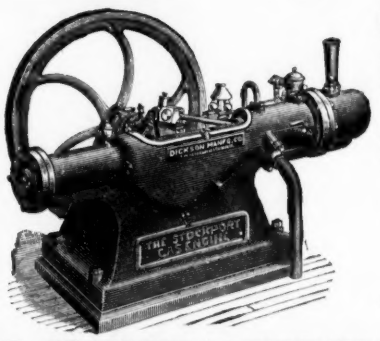

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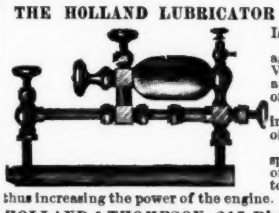

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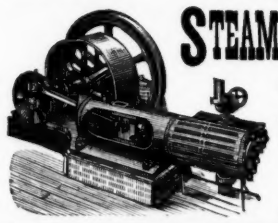

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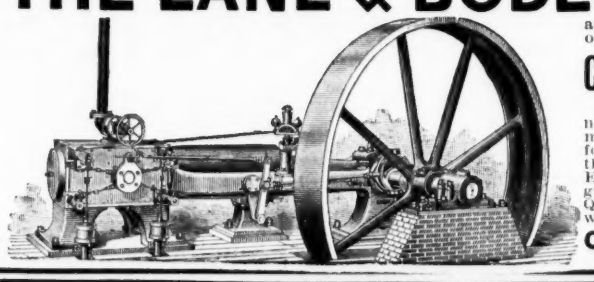

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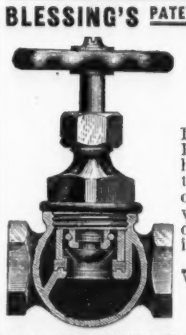

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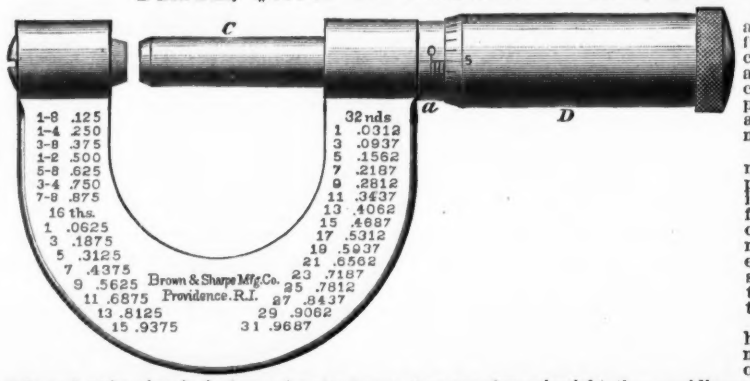

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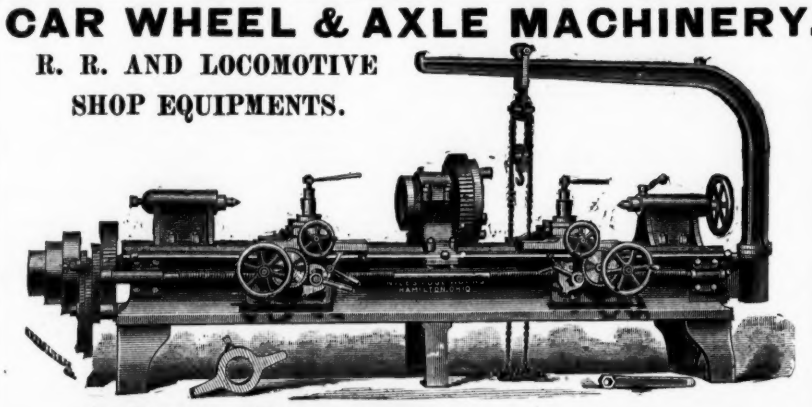

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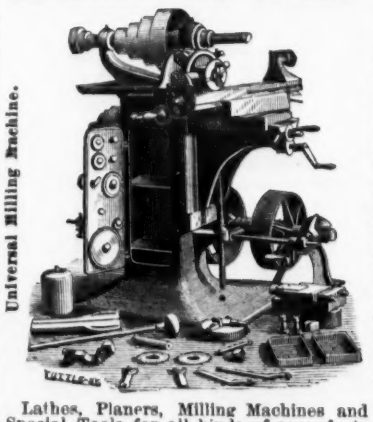

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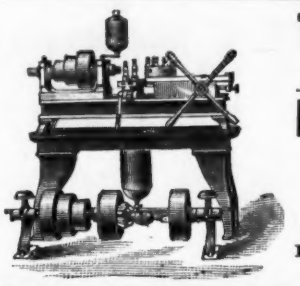

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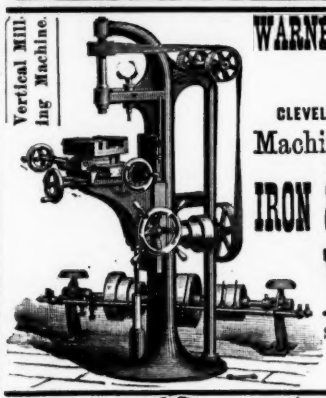

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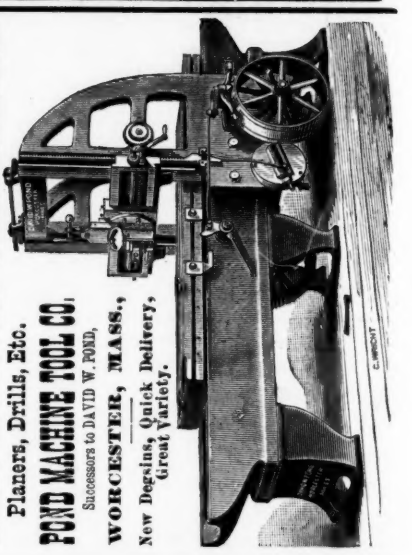

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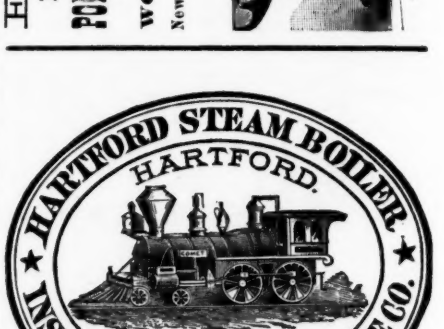

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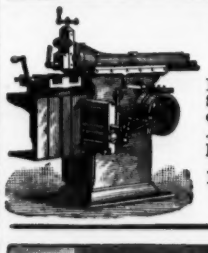

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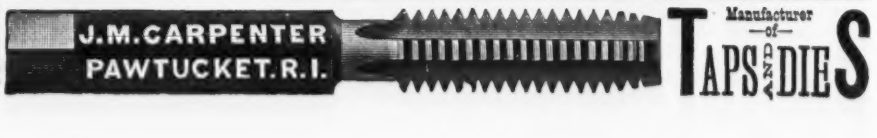
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